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TO CORRESPONDENTS.

Who's Who *asks a question we are unable to answer. It is understood that the registered proprietor is a Mr. Norris, a relative of the common councilman and wholesale stationer of that name. The editorship is said to have been offered to a barrister not overburdened with business, a brother-in-law of Mr. Croll's attorney, and declined on the score of the inadequacy of the remuneration proposed. Messrs. Croll, Flintoff, Dakin, Anderson, and Letheby, with others "of that ilk," are believed to be contributors, and the large number of copies circulated from the office of the Imperial Gas Company has given consisteney to a rumour that the energetic secretary of that company was not quite a stranger to some of its articles. Mr. Henry is a gentleman; and, though it might suit a Machiavellian policy to use ignoble instruments, we apprehend he has no sympathy with the motley group. Alexander Henry and George Flintoff cannot cordially fraternise like the British tar and the French grenadier.*

NOTICES.

With reference to a paragraph under this head which appeared in last month's Journal, we have now to state, that counsel having advised that Mr. Croll had committed a scandalous and flagrant breach of engagement towards the Editor of this Journal, and that an action for substantial damages could be maintained thereon, proceedings have been commenced against him, which will be brought to trial as early as possible. Under these circumstances we are precluded from offering any observations on the subject—reserving all we have to say for the tribunal before which the matter is now pending.

The subscription is 10s. per annum if paid in advance, or 12s. on credit, payable in two sums of 6s. each, due in June and December of each year. All subscriptions commence from the 10th of January.

All Communications and orders for Advertisements to be addressed to the Editor, No. 3, Parliament-street, Westminster.

The offices of the Editor of this Journal will be removed from No. 32, Bucklersbury, to No. 3, Parliament-street, Westminster, on the 19th instant.

Circular to Gas Companies.

One of the principal difficulties against which gas companies have now to contend, and for which they are indebted to the system first set on foot by the Great Central Company, is the impossibility of ever closing their capital accounts. Every yard of new main laid, or old main enlarged, and each new service-pipe or meter fixed, must be paid for out of capital by companies whose practice is to declare dividends based upon the division of the entire earnings of the concern; and thus a constant addition to the permanent capital of the company is effected without any corresponding increase in the value of the property it represents. The shareholder, by this process, receives his dividend with one hand, and pays back a portion of it with the other in the shape of calls on new shares.

These reflections are chiefly suggested by the necessity one of the metropolitan gas companies finds itself under, of issuing a large amount of new shares at a time when it has but recently ceded to other companies something like one-half of the district it has for many years supplied, and when its original shares are at 45 per cent. discount. The new issue must either be made at the market price, or have preference over the old issue; in either case, the interests of the present shareholders are sacrificed to the necessities which the principle of dividing the entire of the profits has entailed upon the company. A prudent mill-owner, or a manufacturer, appropriates a small portion of his profits towards a fund for providing new and improved machinery, and for extending his powers of production; and so ought all well-regulated gas companies: nor can the price of gas be considered as remunerating till a 6 per cent. dividend has been paid, and such provision made. Of course these observations are not intended to apply to the large and important additions to plant which may be from time to time requisite, but to the minor expenditure in meters, service-pipes, and mains in old districts, to meet an increase in the quantity of gas consumed therein.

In another part of our columns we publish a contribution from Dr. Normandy, on the oil of vitriol question, in which the well-known statements of Mr. L. Thompson are, for the most part, confirmed. Dr. Normandy, however, believes that he has detected a small quantity of oil of vitriol in the condensed products, in consequence of a black stain which these give with sugar. But this stain equally results, as we have ourselves witnessed, from the action of sulphurous acid, and therefore we cannot agree with Dr. Normandy's conclusion on the matter.

Nor can we attach much value to an experiment made upon so small a quantity of ammonia as ·182 gr., or less than one-fifth of a grain. The well-known volatility of this substance implies some loss by the operation of analysis, and the escape of even $\frac{1}{10}$ of a grain would totally destroy Dr. Normandy's conclusions.

Respecting the quantity of sulphuric acid which may be had from 100 cubic feet of London gas, Dr. Normandy more than corroborates Mr. Thompson's experience, which gives a minimum of 40 grs.; whereas Dr. Normandy finds 49·63 grs. in the Imperial gas of the Pancras station by following Mr. Thompson's process, which proves that the Imperial gas is worse than the average, and not better, as Dr. Normandy incorrectly argues, though he obtains but 3·82 grs. by that of Dr. Letheby, thus proving that the latter gentleman has never yet employed a perfect process; and of all these 49·63 grs., Dr. Normandy can detect but 1·275 grs. in a free state, and that, too, by an analysis to which every one must, in reason, object.

An act of rather a novel character has received the royal assent during the past month, which deserves special notice. The Ratcliffe Gas Company was incorporated in 1823, for supplying a small district on the northern bank of the Thames, in the vicinity of the London and St. Katharine's Docks, and a penalty of 5s. per cubic foot was imposed for all gas supplied beyond the limits of the act. Some years subse-

quently the Thames Tunnel was completed, and one half of it has been lighted by the Ratcliff Company, the other half being lighted by the Phœnix Company, whose works are on the southern shore. In the autumn of last year, when the division of the districts between the Surrey companies took place, the Tunnel lighting was handed over to the Surrey Consumers' Company, much to the dissatisfaction of the Tunnel Company, who accordingly ceased all dealings with the Surrey Company, and commenced taking the whole of their gas from the Ratcliffe Company. Hereupon some machinery was set to work, by which a series of actions were commenced against the latter company for infractions of the 68th clause of their act, one of which was reported in the last JOURNAL, the total penalties sought to be recovered being something like £600,000. Under these circumstances, the Ratcliff Gas Company came to Parliament late in the session for relief; and, in spite of the opposition of the Surrey Company, the standing order of the Houses of Parliament were suspended, and a bill has passed relieving them from all the penalties which a strict construction of their original Act of Incorporation had rendered them liable to.

The London coal market has been tranquil during the summer months, the minimum price of gas coals having been 15s. 6d. Freights are now on the advance, and parties, who have not covered themselves by contracts, will have to pay advanced prices for their winter's supply.

TESTIMONIAL TO LEWIS THOMPSON, ESQ.

IT is with no ordinary pride and pleasure that we direct attention to an advertisement contained in our present issue, in relation to a spontaneous testimonial of esteem and respect tendered to our talented and highminded correspondent, Lewis Thompson, Esq., by One Hundred of the principal managers and engineers of gas works in Great Britain, in acknowledgment of the obligations under which they feel themselves for his "ingenious investigations into the nature and property of coal and the processes used in its distillation, and his disinterestedness in imparting information upon the true principles on which the manufacture of gas should be conducted." Amongst the subscribers are to be found parties connected with the management of every metropolitan gas work except three (whose peculiar position will account for their absence from the list), and the chief provincial ones. Such a unanimous and universal expression on the part of our professional brethren is unprecedented in the annals of any branch of science; and had it not been thought more agreeable to the feelings of the party thus honoured to limit the subscription to gentlemen professionally engaged in connection with gas works— excluding thereby all directors and shareholders, from whom, as traders, he has uniformly declined to accept any favour or reward—the list would have been enormously extended.

Due notice will, we trust, be given of the presentation of the testimonial, and an opportunity will, we hope, be afforded to all who have not been permitted to contribute to the fund, of testifying by their presence the respect they entertain towards Mr. Thompson, and the high estimation in which they hold his great and varied talents.

TURF GAS.

IT would almost seem as if the laws which govern the movements of comets had some sympathetic connection with those which in this country regulate the taking out of patents for what are called "new inventions." Not that we wish to be understood as insinuating that new inventions are as plentiful as new comets—far from it; but what we mean is, that as each individual comet has a periodical revolution, in which, after visiting other spheres, it returns to this terrestrial neighbourhood, so we find that many "new inventions" have a periodical circuit, in which they visit, no doubt, other parts of the world, and return again to make application for new patents in this country. Every person knows how difficult it is to calculate the return of a new comet; it is the same with a new invention at the Patent-office. We were shown, a few days ago, the copy of a recent patent for an invention, the original patent for which first appeared in the year 1781; consequently, this invention must have a cycloidal revolution of 73 years, and will not again be visible at the Patent-office until the year 1927: this is an instance of a long revolution. We publish this month the specification of a patent granted for an invention, which has a short revolution, and is, no doubt, destined to become an established favourite with our successive Attorneys-General. It will be found in its proper place in the present number, and at page 394, vol. ii., the first or original specification of the same invention may be perused, for the year 1852. The latter is under the names of George Lowe and Frederick John Evans; the former in that of John H. Johnson, as a communication from Messrs. Koechlin, Duchatel, and de Perpigna, foreigners; so that the idea embodied in this patent has evidently obtained a passport, and travelled abroad, where it has been caught by the foreign gentlemen in question, and ultimately confided to the keeping of the said John H. Johnson. The rate of revolution is, therefore, easily ascertained; and if we knew the exact address of Messrs. Koechlin, Duchatel, and Perpigna, there would be no difficulty in calculating how many miles it travelled per day. At all events, it is now certain that the next application for a "Great Seal" for this identical discovery will be made on the 9th of February, in the year 1856, when the same idea ought to be "visible" at the Attorney-General's office, to the naked eye of the observer, and "without the aid of a lens."

It will be seen that the patent of Messrs. Koechlin, Duchatel, and Perpigna, is essentially for making gas from peat, turf, wood, sawdust, and vegetable refuse, and mixing this gas with the illuminating gas made from tar, oil, &c., so as to obtain a mixed gas of moderately illuminating power. Now, the patent of Messrs. Lowe and Evans is "for making gas from peat, wood, sawdust in a damp or dry state, spent tanner's bark, and like substances, capable of yielding an inflammable gas; and this gas is then mixed with the illuminating gas made from cannel coal, coal, lignite, resin, pitch, tar, oil, retinite, or other substance or substances capable of yielding carburetted hydrogen gas, by which means such a combination of rich and poor gases may be produced as will be exactly suited to the purposes of illumination." "We therefore," say Messrs. Lowe and Evans, "propose to mix the rich and poor gases together in such proportions as will be needful to produce a highly illuminating quality of gas;" and, as there is no definite rule by which this can be done, it is suggested that "the mode in which the gas burns in issuing from the retort will be a sufficient test for the workman." If it be too rich, "it will burn with much smoke"; if too poor, "it will burn blue and give little light." The poor gas may be passed directly into the retort evolving the rich gas; or it may be stowed away in a gasholder, and used when wanted; and this latter method is preferred by the patentees, because "in that case a more uniform and constant supply of poor gas to the coal retort can be relied on."

The claim of Messrs. Koechlin and Co. is for the extraction of gas from peat, turf, tar, and other articles, before mentioned, by dividing a portion of two processes, whereby the inferior gas, derived from the usual materials, is obtained separately from the superior gas derived from the oils and essence also referred to, being afterwards combined or used separately for lighting or heating purposes.

Messrs. Lowe and Evans claim the combining of gases, which possess different degrees of illuminating power, by the introduction of gas obtained in any of the ways above indicated, into retorts or vessels containing carbonaceous matters under distillation.

Now, if words mean anything, it is very clear that the patent of Lowe and Evans not only over-rides the subsequent one of Messrs. Koechlin and Co., but is, moreover, vastly better in all respects, and goes much farther into the subject; indeed, but for the obvious priority of its title, it might have been regarded as an important improvement of the process patented by Koechlin and Co. Of this, at all events, there cannot be a moment's doubt, that, if there is any substantial advantage in this mode of manufacturing illuminating gas, then the process of Lowe and Evans must be preferred to that of Koechlin and Co., whether we regard the extent of its range or the practicable nature of its arrangements and application.

But this is not the only instance in which the patent of Koechlin and Co. is "a day behind the fair"; it claims a mode of making "grease for lubricating railway-carriages and other wheels," which differs no more from the previously patented process of Mr. Little for the same purpose, than does the gas plan differ from that of Lowe and Evans.

By referring to our number for February last, page 344, the reader will find a copy of the specification of Mr. Little, for the manufacture of lubricating materials from the bituminous

oils of coal and coal tar, in which the above process of Messrs. Koechlin and Co. is altogether anticipated. We consider it merely necessary to reproduce, side by side, a part of the two specifications, and leave the public to form an opinion how far patents, like comets, revisit the world at definite periods, as we have surmised.

KOECHLIN'S PATENT.

For converting oil No. 1 into grease, a copper boiler is employed, placed over the furnace, and fitted with an emptying cock. In this boiler is placed white tallow 50 parts, and a soda lye of 10° Cartier 115 parts. This mixture is gently heated and agitated, and, as the mass rises, 100 parts of water are added. When the thickening is finished, and the materials sufficiently reduced to a paste, 100 parts of the oil No. 1 are added. The whole is then raised to a boiling point again, and by opening the discharge-cock, it is run into tubs or troughs, fitted with agitators, where, after continual agitation, it is allowed to cool. The grease thus prepared is particularly adapted for the lubrication of carriage wheels and heavy machinery.

LITTLE'S PATENT.

To 100 parts of tallow, melted in a caldron, he adds 235 parts of a solution of caustic soda in water, making a solution equal in strength to 10° or 11° Beaumé. This mixture is boiled until saponification takes place, when 90 parts more of water are added, and the whole again boiled, until the ingredients are thoroughly combined. This constitutes a soda-soapy compound. To this he adds a potash-soapy compound, of 70 parts of a solution of caustic potash, equal to 8° or 10° Beaumé, boiled with 30 lb. of a fish or vegetable oil —either whale oil or linseed oil— until saponified. The two soapy compounds, being thoroughly mixed by boiling, are then poured into a vessel containing 150 parts of the greasy oil distilled from the crude oil of coal, and the whole is then mixed together by stirring, until it begins to acquire a thick consistence by cooling, when it may be allowed to remain. This supplies a solid grease, suitable for the journals of railway carriages or other mechanism.

It is needless, after the above extracts, to remark that the process of Messrs. Koechlin and Co. contains no such novelty as, in the eye of the law, constitutes a patent right; consequently, the claims put forth in their specification must be regarded as null, void, and of no effect whatever. Nor is this perhaps, after all, very much to be regretted, for the use of peat, in a variety of ways, has been so extensively applied to the manufacture of gas, and has so signally failed in every instance, that no one but an ignorant enthusiast would now dream of employing that substance wherever coal can be bought and coke sold throughout the civilised world. More than thirty-five years ago, gas was made from peat in Belfast and other towns in Ireland—and, if there be under heaven any locality where such a scheme can prosper, surely Ireland is that spot. With the finest peat at a merely nominal cost, and with a ready sale for the charcoal produced, Dublin offered every advantage, and more especially so at the time we mention, when even coal gas was three times its present price. But the thing failed—totally—as a commercial speculation. Since that time we have seen peat-gas projects and patents in abundance; they have risen, glittered, and burst, like the soap bubbles of children, and nothing remains to tell even where they were. By far the simplest and best thing of this kind was the process of Mr. George Lowe, patented on Oct. 8, 1846, "for improvements in preparing peat, in combination with resin, pitch, tar, oil, fat, and other hydro-carbonaceous matter, and making gas therefrom;" yet this failed commercially, or, in other words, would "not pay." Nevertheless, its details are strictly philosophical; and, judging *à priori* from the simplicity of its arrangements, we should have been misled, perhaps, into the expression of an opinion strongly in its favour. It was tried at Amiens—well and carefully tried—on a large scale, too; but, as we have before said, without success in a pecuniary sense. With Messrs. Koechlin and Co.'s patent lying before us, and with the accumulated knowledge of more than the third of a century to guide us in arriving at a conclusion, we hesitate not for one moment to express the most unfavourable opinion possible in respect to this project. That it will ever be adopted by any gas manufacturer in this country we do not for an instant suppose; but, if our observations induce the patentees to watch carefully over the details of their process—to suspect the correctness of everything that resembles a favourable indication—and, above all, not to incur a ruinously expensive outlay in seeking to establish so very dubious an enterprise, we shall have discharged our duty as journalists, and, at the same time, rendered an essential service to the parties most interested in the result.

THE GENERAL BOARD OF HEALTH.

THANKS to the manly and judicious eloquence of Lord Seymour, we are no longer under the necessity of commenting upon the mischievous character of Lord Shaftesbury's Nuisance Bill, or the existing evils caused by Mr. Edwin Chadwick's sanitary vagaries. The former has been most appropriately consigned to the "waste-paper basket" of the House of Commons; and the originator of the latter is henceforth to exercise his pernicious activity within the circumscribed area of the pension-list, until the period arrives for his transference to that "extramural" repose which he so lauded in the days of his obnoxious restlessness. The principle upon which £1000 a year has been awarded to him might, in our opinion, be very fairly called in question, differing, as it does, in nothing from the mode in which Alaric the Goth, Rob Roy, or any other public disturber was formerly got rid of. Hugely pleased with the result, we are not, however, now disposed to examine too closely the preliminary details, and, therefore, willingly concede £1000 blackmail for so satisfactory a purpose; indeed, we would rather have doubled the sum than have lost the opportunity of buying off so much unmitigated annoyance. But all this is clearly upon the understanding that Mr. Chadwick will rigidly adhere to the agreement, for as to the notion of Mr. Henley and Sir William Molesworth, that "Mr. Chadwick may be again employed in the public service," we protest against it. If the Ministry consider him fit for the public service, let them say so, and make an attempt to keep him in office; the country will very speedily settle that question; and if he is not fit for that service now, in the very capacity for which he thinks himself so well adapted, then away with him at once and for ever. We have no hesitation in declaring his total unfitness for any service except, perhaps, that of the Czar of Russia or the cotton plantations of Mr. Legrée. Amongst a horde of serfs or black slaves, his principles might be tolerated; but for such a man in this country there is no place, and no position save the pension-list: let him be content, then, and bless his lucky stars. Hundreds who have really served their country and benefited the human race at large would only be too happy to receive one-fourth of that which has been so readily awarded to his equivocal merits.

No person doubts, or can doubt for a moment, that some supervision is requisite on the part of Government, in respect to so important an object as public health; and no moderately well informed man can question the fact that the rate of mortality amongst the lower orders is much greater than obtains with those of a superior grade; for this, in fact, constitutes the starting-point of the inquiry. But can any one, or ought any one, with our present restricted knowledge of the subject, to declare dogmatically that the cause of this increased mortality arises from dirt, from ill ventilation, or from any one circumstance whatever? Certainly not; for, in all probability, a great variety of causes leads to this result; and bad diet, combined with unwholesome beverages taken to excess, and general irregularity of food, have more to do with the evil alluded to than all the dirt and ill ventilation put together. In respect to these latter, the Divine Being has kindly created laws which neutralise or prevent the mischief: the unwholesome vapours of filth are rapidly oxidised and destroyed by the atmosphere, and the principle of gaseous diffusion renders more effective service than all the draughts and ventilating contrivances ever conceived by man. But there is no principle at work to secure the proper cooking of our food—no law of nature for giving each person so much and no more than is sufficient either of meat or of drink. On the contrary, intemperance in both is within the reach of all at times, and with the lower orders these things are commonly managed so as to produce an alternate feast and famine. Those who have watched our labouring population in large towns with care, cannot fail to have remarked that Saturday night, Sunday, and perhaps Monday, are the periods of repletion to excess with this class; whilst the remainder of the week is devoted to starvation or the ingestion of mere garbage. Crocodiles, when hungry, are said to swallow stones; and Captain Cook mentions a tribe of savages who filled themselves occasionally with a kind of clay; but many of our poorer class do worse than either of these, for they swallow vegetable and animal refuse in a state of acescent or putrefactive fermentation, and thus, as it were, open wide the portal of disease and death. It is not external but internal filth which originates pestilence, and should be more particularly guarded against: witness the individuals engaged as nightmen and in other most disgusting occupations, who, on this very account, are generally well paid and, therefore, well fed. These men do not suffer from disease in an abnormal ratio; quite the reverse: they are

more free from morbid affections than the upper classes, and possess a degree of bodily vigour evidently proportioned to the food they eat rather than to the occupation they follow. This is the great sanitary question of the day—to procure for the lower orders good and wholesome food, and teach them the advantage of regular habits. Not that we either depreciate or deny the vast advantage of cleanliness, for without this the lower orders never can obtain the kind of food necessary for health; but what we wish to inculcate is, that this cleanliness is but one of the adjuncts to a sanitary reformation of the people, and not a principle in itself. The real principle is, as we have before said, to supply healthy elements of nutrition; for, if the substances given for assimilation be corrupt or defective, it follows as a consequence that any person so fed will be liable to, if not actually infected with, diseases of a malignant or putrid character. Is there, at the present day, anything which a good agriculturist pays more attention to than the feeding of his cattle; and is not this feeding made dependent upon a careful supervision as to quality and quantity of food? Why, then, are we to go on as if the human animal was an exception in this respect to the general rule? Cleanliness is well, very well, both for man and beast; but who ever fattened cattle by cleanliness alone? The real advantage of cleanliness must arise out of the increased comforts which the poor man finds in his own home, and which induce him to seek that home rather than the taphouse, and to find there the temptations of a comfortable meal, instead of his present bread-and-cheese fare by the side of an alehouse fire. The sanitary reform wanted is something of a wider and more comprehensive nature than ever entered the stoutest conception of a Chadwick. That gentleman was no less remarkable for incorrect analogies than for absurd deductions, and, whilst rushing at a conclusion with the headlong folly of a blind horse, too frequently exhibited a dogged obstinacy worthy only of an ass!

But he is gone, and, if the thing is possible, "peace be with him"; we want other men and other measures, to secure not only the confidence but the sympathy and assistance of all classes in the great work of public improvement. Lord Palmerston's contemptible witticism, about a "dirty and a clean party," proves only this, that his lordship is not altogether free from a *soupçon* of humbug; and it would be as well if he henceforth takes for granted that it is much easier to to make and act upon the laws of men than to comprehend and appreciate the laws of nature. A lord may do the first with ease, but it requires a philosopher to carry out the last.

As is usually the case with half-informed individuals, certain philosophers, of the Palmerston and Chadwick school, have proposed a very easy mode of solving all our sanitary difficulties. According to these worthies, nature has provided man with the faculty of smell for the express purpose of avoiding unhealthy emanations; so that he is able at once to discover in the repugnant odour of any substance, its deleterious character and influence upon his health and well-being. This would be a very ready method of dealing with the question, and carries upon its face an air of probability from the well-known faculty, enjoyed by most animals, of instinctively recognising the description of food they require, and rejecting those things which are injurious to them. But, whilst instinct was given to animals at large for their guidance in this respect, reason was given to man, in particular, for his, as a substitute; and, therefore, no analogy can hold good which is drawn from such instinctive data. Human beings have clearly been intended to "replenish the earth," and to live in every part of it—a quality possessed by no other class of animals; thus, in the tropics as at the poles, he can live and thrive; on the land and on the water, he equally finds a home and a resting-place; his very senses become obedient to his circumstances—the miller, the boiler-maker, and the brazier, hear nothing of the noise they create; the perfumer and the druggist are insensible to the odours which surround them; the hand of the blacksmith accommodates itself to the burning touch of hot iron; the dreariest views become pleasing by association; and sleep can "seal up the shipboy's eyes even on the giddy mast." Nor is man's power of living on various kinds of food less remarkable; he is, in fact, ominivorous. The Hindoo swallows a dishful of boiled rice, and is content; the Laplander drinks the warm blood of the reindeer; the Esquimeaux is satisfied with train oil; and, whether from vegetables or animals, human beings are able to find sustenance all the world over. Do these circumstances not prove, then, that mere animal instinct is in this case superseded by a higher function, and that it is absurd to draw an inference applicable to man from the conditions assigned to a brute? Yet all the learned twaddle which has been thrust upon public attention during the last ten years, through the medium of tons of blue books, has had nothing better than this simple brute instinct for its foundation. Messrs. Chadwick and Co., never seem to have imagined that any other part of the brain but the olfactory nerve was needed to secure health. In one sense, at least, they certainly were "noseologists."

But let us hope that a more comprehensive view of so important a subject will in future be taken by the new Board of Health; that some attempt will be made to arrange and gather together the facts connected with diseases in general, and more especially those of an epidemic character; that an inquiry will be instituted as to whether, during the prevalence of an epidemic, other diseases do not diminish; whether individuals labouring under some diseases are not exempt from some epidemics; and whether epidemics are not frequently accompanied by other phenomena, which exhibit themselves upon different animals or vegetables. Thus, for example, whether the cholera, the potato blight, the vine blight, &c., have not one common origin, or, at least, a general connection with each other.

Truly, there is much to be done; and now, when the great theorist is disposed of, we may hope that practical common sense will have its day.

Communicated Articles.

DR. NORMANDY ON THE IMPURITIES IN COAL GAS.

On the 8th of May last, Dr. Letheby made a report to the Commissioners of Sewers of the City of London on the gas supplied to the metropolis, which, I think, is well deserving of attentive consideration, both on account of the statements therein contained, and of the (in my opinion) somewhat exaggerated fears which have been excited in the minds of many persons by the publication of that report, and of various newspaper articles which have alluded to and commented upon it.

Living, as we do, in an age in which the sources of contamination and of sophistication have, through accident, neglect, consequence, or design, more than kept pace with the wonders accomplished, and the comforts realised by productive industry, the actual causes of danger to the public health are, unfortunately, plentiful and imminent enough, without gratuitously augmenting their number; and we are already supine enough in obtaining and enforcing measures for the removal of real nuisances, without diverting the public attention from those momentous questions to matters which, if not perfectly innocuous, are, at any rate, of so subordinate a nature as to admit of their being overlooked until after the extinction of more grievous abominations than *oil of vitriol*, as one of the products of the combustion of gas, and than the influence, in a hygienic point of view, both of that oil of vitriol and of the fetid tarry impurities which gas holds in suspension.

Whether gas yields, by burning, free sulphuric acid (oil of vitriol) or sulphate of ammonia, is a question which has lately created a good deal of angry controversy between two distinguished chemists, namely, Dr. Letheby and Mr. Lewis Thompson: the first of these two gentlemen asserting that all, or almost all, the sulphuric acid so generated is in the form of oil of vitriol—that no sulphate of ammonia is produced, nay, that if such a salt were produced, it would not resist the decomposing action of burning gas; whereas Mr. Lewis Thompson contends that all the sulphuric acid resulting from the combustion of gas is altogether, or very nearly so, in the form of sulphate of ammonia, consequently in a saturated and innocuous state—in fact, that no oil of vitriol is produced at all, but that the strong reddening of litmus paper alluded to by Dr. Letheby is due to the presence of bisulphate of ammonia, and possibly of formic acid.

Now, if by *oil of vitriol* we are to understand the strong and concentrated sulphuric acid of commerce, there is no doubt but that the combustion of gas does not yield such an acid, even after the spontaneous evaporation of the water produced by burning gas; but if, on the contrary, no other meaning was attached to the term, *oil of vitriol*, than free sulphuric acid diluted by a large quantity of aqueous vapour or condensed water, then, and in that case, it is for me an unquestionable fact that the combustion of gas (at least, such as is supplied by the Imperial Gas Company, with which alone I experimented) yields both *free sulphuric acid* and *sulphate of ammonia*, which may be proved as follows:—

The combustion of 34·5 cubic feet of gas, under a glass funnel made from the neck of a broken retort, bent in a proper manner, and connected with a Liebig's tube-condenser, gave me in 99 hours, 10,800 grains-measure of water, reddening litmus paper pretty strongly. This water was evaporated to about 400 grains measure; it had then a very strong acid reaction on litmus paper. The cover

of a porcelain crucible was then coated with a solution of 1 part of cane sugar in 30 parts of water, as directed by Runge, heated by steam, and a small drop of the above concentrated gas water being placed upon the porcelain cover, coated with sugar as just said, and heated by steam, an intensely black stain was *immediately* and *permanently* produced, owing to the decomposition, at that temperature, of the sugar by the presence of the *free sulphuric acid* contained in the water: free sulphuric acid, according to Runge and H. Rose, being the only acid which behaves in this manner—the solutions of the neutral sulphates, and of the sulphates which redden litmus paper, failing in producing this characteristic reaction, which consequently is an excellent one for the detection of *sulphuric acid in a free state* from that of *sulphuric acid in a state of combination.*

It is true that sulphate of copper, when so treated, produces, after a while, a stain, which is due to the formation of a little yellow hydrate of oxide of copper; but this reaction cannot be mistaken for that produced by sulphuric acid, which, instead of giving only a faint drab colour, as with sulphate of copper, yields, on the contrary, an intensely black stain.

A concentrated solution of bisulphate of ammonia, which I had prepared, being submitted to the same test, produced, after an interval of a few minutes, an insignificant brownish tinge at the edges of the drop, which brownish tinge disappeared completely in the course of about two hours; whereas the black stain, produced by sulphuric acid *in a free state,* takes place *immediately,* and is *permanent.*

And whereas the condensed water operated upon had been the result of the accumulation of several days' burning, at the rate of from 1370 to 1400 grains measure of water per diem, and was tested as just described only, at the end of six or seven days, this mode of analysis was objectionable, on account of the possible transformation of sulphurous into sulphuric acid. To avoid this source of error, each drop of condensed water, as it fell from the end of the tube condenser, was received into a platinum capsule, heated by steam. After several hours' burning, the condensed water, thus evaporated to an extremely small bulk as it gradually fell into the capsule, being tested with the solution of sugar as described before, produced again a black stain, but of a much more intense hue, owing to the greater state of concentration of the liquor.

These experiments, though entirely satisfying me of the presence of free sulphuric acid, having, however, appeared inconclusive to a chemical friend of mine, to whom I communicated them—in as much, as he informed me, that by putting one-tenth of a grain of sugar into a little sulphurous acid water, quite free from sulphuric acid, and evaporating it to dryness, he had obtained, he said, a bright greenish-black varnish all over the bottom of the dish—it became necessary for me to verify his experiment, in order to determine *de visu* whether this greenish-black varnish had a different appearance from that which is produced by highly diluted sulphuric acid when so treated; the more especially as, from the reaction he had observed, he expressed his belief that it was not at all due to sulphuric acid, but that it implied the existence of either sulphurous or hyposulphuric acid; and that he inclined to regard it as a test for *sulphurous acid,* which only becomes manifest with sulphuric acid by the decomposition of that acid. I therefore prepared some perfectly pure sulphurous acid water, by heating in a flask some concentrated sulphuric acid and mercury, and received the sulphurous acid gas which was evolved into a small Woulf's apparatus, consisting of two bottles half filled with water. After the water in these bottles had become saturated, I submitted several drops of the saturated water of the second bottle to the sugar test, but without obtaining the slightest stain. I then dissolved one-tenth of a grain of sugar into a small quantity of the same water, and evaporated it to dryness over a jet of steam; but did not obtain the faintest trace of the greenish-black varnish mentioned by my friend; nor did I even succeed in producing the least appearance of a discoloration with the sulphurous acid water contained in the first of my two bottles: whence I conclude that, since the reaction I have just mentioned was obtained by the gentleman above alluded to, it is clear that the sulphurous acid water he operated upon *must* have contained a small quantity of sulphuric acid. I am so much the more inclined to think so, that, on examining with solution of chloride of barium the sulphurous acid water just spoken of, four days after its preparation, a slight turbidness was produced by that reagent, clearly indicative of the presence of a trace of sulphuric acid, due to the spontaneous oxidisation of the sulphurous acid in solution; and in effect, on dissolving one-tenth of a grain of sugar in that liquor, and evaporating to dryness, I obtained, after a somewhat protracted exposure to the action of steam, an exceedingly slight greenish-yellow varnish all over the plate, which is quite characteristic of the presence of a trace of free sulphuric acid. When a clear liquid contains less than one part of this acid in about 400 of water, the stain produced by treatment with sugar is not black, but it has a greenish colour, which diminishes in intensity, and at the same time becomes of a greener hue, in proportion as the quantity of free sulphuric acid is smaller: one part of free sulphuric acid in 8000 of water gives yet a perfectly distinguishable light greenish film.

These experiments appear to me perfectly conclusive; and it is, therefore, evident that the condensed water resulting from the combustion of gas contains *sulphuric acid in the free state,* as asserted by Dr. Letheby.

In order, however, to complete the observations on the present inquiry, I may mention the following experiment of another chemist, communicated to me by the same friend. It is this:—

If into two ounces, for example, of distilled water, ten drops of a solution of quite pure sulphurous acid be poured, and if, after *slowly* evaporating the whole almost to dryness, an exceedingly small particle of sugar be then added, and steam applied for about five minutes, a black stain is obtained, due to the transformation of the sulphurous into sulphuric acid. This statement, as I have ascertained, is quite true; but not so the conclusion drawn from it by the chemist who performed the experiment, viz., that "It is impossible to evaporate sulphurous acid in solution without forming sulphuric acid." That conclusion, I beg to repeat, is not correct, because of the above solution; or even if a saturated aqueous solution of perfectly pure sulphurous acid be introduced into a pipette provided with a stopcock, and so adjusted as to allow the contents thereof to fall into a platinum dish heated by steam, drop by drop, at such intervals that the evaporation may keep pace with the supply, it will be found that no sulphuric acid is then produced; and, consequently, that the sugar test produces no black stain whatever. It is, therefore, possible thus to evaporate even a saturated solution of sulphurous acid without converting any portion of it into sulphuric acid; this being the case, the experiment related a few paragraphs above, in which the condensed water was evaporated gradually as it fell from the end of a Liebig's tube-condenser, appears to me to justify my assertion, that free sulphuric acid is one of the products of the combustion of gas, which sulphuric acid is probably due to an *immediate* transformation into that acid of a portion of the sulphurous acid which such a combustion produces pretty largely, as will be shown by-and-by.

On the other hand, the condensed water obtained from the combustion of gas being further evaporated by steam to a very small bulk, and mixed with solution of caustic soda, immediately evolved ammonia, recognisable by its odour, by the alkaline character of its fumes on test papers, and by the other reactions of ammonia.

I have also ascertained that the statement made by Mr. Lewis Thompson, namely, that the white powder which had deposited on the sides of the glass funnel, and round the top of a wire-gauze chimney used to steady the flame of the burner, is sulphate of ammonia; because on dissolving it in pure distilled water, dividing into two portions, and testing one of these portions with a solution of chloride of barium, a white precipitate of sulphate of barytes was produced, perfectly insoluble in water and in acids; and because, on evaporatng the other portion to a very small bulk, and adding recently slacked lime thereto, an odour of ammonia and a bluing of reddened litmus paper were produced.

It is, therefore, evident that *sulphate of ammonia* exists among the products of the combustion of gas, as asserted by Mr. Lewis Thompson.

The burner I used was nothing more than the single-hole pipe left when an ordinary argand burner is unscrewed and removed; and the flame was kept as high as consistent with the prevention of smoke.

Having thus established that gas yields, by burning, both *free sulphuric acid* and *sulphate of ammonia,* I proceeded to determine their respective quantities as follows:—

Having burnt 62·3 cubic feet of gas in the course of 117 hours, condensed the water resulting therefrom as described before, and, of course, washed the whole apparatus with pure distilled water, in order to dissolve and collect the solid sulphate of ammonia which lined the sides of the glass funnel, and had gathered in exceedingly small quantity round and a little within the hole of the burner, I evaporated the whole mass of the liquor, so as reduce it to a small bulk; I transferred it to a retort, added thereto a large excess of pure caustic potash, and connected the retort to one end of a Liebig's tube-condenser, provided at the other extremity with a bulb-condenser, containing 1000 grains measure of sulphuric acid, of specific gravity 1·032, such an acid being capable of saturating exactly one equivalent of ammonia. Heat was then applied to the retort, and its contents were evaporated almost to a pasty consistence. On submitting the acid liquor in the bulb to a careful alkalimetrical assay, I found that a quantity equal to 1·06 division of the alkalimeter had been saturated, representing 0·182 of ammonia.

Therefore, 100 cubic feet of the gas produced by the Imperial Company contain only 0·29 grain of ammonia—representing 1·127 grain of sulphate of ammonia, or 1·808 of bisulphate of the same base.

It would therefore appear that, according to Dr. Letheby's analysis, the gas produced by the Great Central—which is more pure than any other mentioned in his report—contains still nearly double the quantity of "this alkaline impurity" than is found in that supplied by the Imperial.

The amount of sulphuric acid was determined by adding a suitable quantity of pure distilled water to the thick liquid in the retort,

and supersaturating with hydrochloric acid; I then added an excess of solution of chloride of barium, boiled for a short time, and left the whole at rest for about eighteen hours. On collecting, washing, drying, and igniting the precipitate, with the usual precautions, I obtained, on weighing it, 4·8 grains of sulphate of baryte, which, being produced from the combustion of 62·3 cubic feet of gas, represent, for 100 cubic feet, 7·72 of that sulphate; and therefore—

100 cubic feet of the gas produced by the Imperial Gas Company contain only of anhydrous sulphuric acid	2·639 grains
If from this quantity we deduct the amount of that acid fixed by the ammonia previously determined, to wit	0·683
We have, as the sum total of the *free sulphuric acid* yielded by burning 100 cubic feet of that gas	1·956 grains

Nay, if, as I think is the case, the quantity of ammonia which I found exists in the condensed water in the state of bisulphate of ammonia (for we can hardly conceive it in the state of neutral sulphate, in presence of free sulphuric acid), the account would then stand as follows:—

Total amount of sulphuric acid, both in the free and in the combined state, contained in 100 cubic feet of gas	2·639 grains
Quantity of anhydrous sulphuric acid fixed by the ammonia in the state of bisulphate of ammonia	1·364
Total amount of free anhydrous sulphuric acid in 100 cubic feet of the Imperial Company's gas	1·275 grains

And therefore it would appear that, according to Dr. Letheby's analysis, the gas produced by the City Cannel, the Chartered Gas (Curtain-road), the Great Central, the City Company, the Chartered Gas (Brick-lane), and the Commercial, contains respectively, in round numbers, 8, 11, 12, and 13 times more anhydrous sulphuric acid than is found in that supplied to my house by the Imperial Gas Company.

This enormous difference between my analysis and that of Dr. Letheby evidently does not invalidate the statements he has made; but they prove that, however impure the gas of the companies mentioned in his report may be in this respect, that manufactured by the Imperial at the establishment which supplies my district is remarkably free from those impurities, when tested as I have just described.

I have no doubt that, if Dr. Letheby will do me the honour to repeat the experiments with the above-mentioned gas, he will find that the statement I have just made is in strict accordance with truth, and confirms most thoroughly his own words, namely, that, "if there is not a means of preventing the presence of sulphuric acid altogether, there is, at any rate, a means of keeping it down"—not, indeed, "to one-half," but to nearly one-fourteenth "of its present amount." I should, however, say at once here, that there is considerably more sulphuric acid *eventually* produced by the combustion of the above-mentioned quantity of gas, than can be detected by this method of analysis, or by that adopted by Dr. Letheby, and which will be described presently, since these methods only take into account the almost insignificant quantity of sulphuric acid formed at that period, but fail in arresting the sulphurous acid, which in reality, by its subsequent spontaneous oxidisation, is the chief source of the mischief complained of.

I have now to add that, before publishing this letter, I thought it but fair to communicate it to Dr. Letheby, and attentively, as well as respectfully, to listen to whatever observations he might favour me with in reference thereto.

I have already related the various objections which were made in reference to the mode of analysis I employed, and the manner in which I endeavoured experimentally to meet them; I will now proceed to describe the result of my experiments with Dr. Letheby's own apparatus, that gentleman having most courteously sent it me for the purpose of ascertaining whether any modification in the quantity of sulphuric acid, and of sulphate of ammonia, found in my previous analyses, would arise from its use.

This apparatus consists of a Leslie's burner, provided with a little tripod of brass wire, whereon two platinum rosettes (that is, two small discs of very fine platinum wire wound round and round and crossways), of such a diameter as to rest upon the tripod just mentioned, and about half an inch above the strangled or dented-in portion of the glass chimney, which is connected by means of a properly curved and conical glass-tube, with a glass-cylinder with an opening on each end—in fact, similar in shape to the glass cylinder of an electric machine—the farthest aperture of this glass cylinder being provided with a glass-tube of a pretty large bore, and bent upwards. The gas being turned on very low, so as to burn, when ignited, with only a blue flame, the platinum rosette becomes red hot, and the water resulting from the combustion of the gas collects in the glass-cylinder.

This apparatus—apart from the results obtained, and considered only as a means of determining the nature of the products of combustion in reference to their action on public health—appears to me objectionable, because, with it, the gas is not burnt in a normal manner—that is to say, in the condition in which the public consume it. The platinum rosettes produce all the phenomena of Davy's *lamp without flame:* they oxidise the gas as it passes through them; and pungent, irritating vapours are evolved, which are mainly due to the formation of a comparatively large proportion of formic and, possibly, of aldehydic acids—at least, if I may regard the smell, the reduction of terchloride of gold, and of nitrate of silver, to the metallic state as a test of the presence of this acid, such reduction having taken place in a little glass-tray charged with these salts, which I put within the bent-up portion of the tube, at the farthest or exit end of the apparatus.

On examining, however, in the manner already described before, the water contained in the glass-cylinder, and resulting from the combustion of 55·4 cubic feet of gas, I obtained therefrom a quantity of ammonia capable of saturating 0·3 divisions of the alkalimeter. Therefore—

100 cubic feet of the gas contain 0·091 of ammonia—representing 0·356 of sulphate, or 0·567 of bisulphate of ammonia.

On the other hand, the same liquor, tested for sulphuric acid as before related, gave 6·2 grains of sulphate of baryte; and, consequently—

100 cubic feet contain of sulphuric acid, both in the combined and in the free state	3·820
Deduct from that number the quantity of sulphuric acid combined in the state of neutral sulphate of ammonia	0·215
Free anhydrous sulphuric acid in 100 cubic feet	3·605

Or, if we consider the ammonia to be fixed in the state of bisulphate, then we have—

Total quantity of anhydrous sulphuric acid, either combined or uncombined, in 100 cubic feet	3·820
Deduct from that number the quantity combined in the state of bisulphate	0·427
Total quantity of free sulphuric acid	3·393

In either case, therefore—that is, whether burnt in the usual manner, or by means of the contrivance adopted by Dr. Letheby—it is evident that the quantity of sulphuric acid in gas is much less, at least as far as the Imperial Company is concerned, than found by Dr. Letheby; and certainly exhibits, on the part of the companies mentioned by him, more care in the production of a good dividend for the shareholders, than of a good gas for the public; for I have no doubt but that the large quantity of sulphuric acid detected by Dr. Letheby must be referred to the fierceness of the fire employed to heat the retorts, with a view to make them yield a large amount of gas, irrespective of its quality—which large quantity of sulphuric acid is probably very far from representing the total amount of this acid in reality produced by the combustion of gas, if I may judge from the enormous increase which a more searching mode of analysis has enabled me to detect. In effect, if gas be burnt in the way described by Mr. Lewis Thompson, namely, by supplying the flame with a large excess of ammonia, it will be found that the whole of the sulphurous acid will be arrested. I found, in fact, that by fixing round the burner a dish containing liquor ammoniæ fortissimæ, so as to supply the flame with an atmosphere highly charged with volatile alkali, the combustion of 9 cubic feet of gas in the above conditions gave me 13·1 grains of sulphate of baryta, which represents for 100 cubic feet no less a sum than 49·63 grains of sulphuric acid! as follows:—

Free sulphuric acid produced directly by the combustion of 100 cubic feet of gas	1·27
Free sulphurous acid produced directly by the combustion of 100 cubic feet of gas = 37·5 grains, which, by oxidisation, become converted into sulphuric acid	47·00
Combined sulphuric acid in the state of bisulphate of ammonia	1·36
	49·63

From which total, if we deduct the latter item, namely, 1·36, leaves 48·27 grains of free sulphuric acid as the ultimate result of the combustion of 100 cubic feet of the said gas—that is, more than three times, and more than five times the quantity respectively detected in the Commercial, which is the worst, and in the City cannel, which is the best gas quoted in Dr. Letheby's report.

But whether sulphuric acid is found as one of the immediate or almost immediate products of the combustion of gas, or whether that combustion produces immediately sulphurous acid only which subsequently becomes converted by spontaneous oxidisement into sulphuric acid, does not in the least affect the practical question at issue. *If free sulphuric acid is finally produced,* it matters but little, as far as the public health is concerned, whether this takes place directly or indirectly—mediately or immediately. As to me, I am at present satisfied that both sulphurous and sulphuric acid are, as it were, at once formed when gas is burnt, and that the quantity of sulphuric acid eventually formed by the oxidisation of the sulphurous acid gas, which escapes undetected by the other methods of analysis just described, is, in reality, more considerable than generally suspected; and that the mischief is done probably during the last half hour before withdrawing the charge from the retorts, in consequence of which the gas, however good, manu-

factured during the first period of the operation, is wholly contaminated by the bisulphuret of carbon resulting from the decomposition of the iron pyrites in the coals by the undue heat to which the retorts are submitted at the end, with a view to make them yield more gas. If this be really the case, we have no need to wait for further improvements in the manufacture of that commodity, and the remedy is a very simple one, since it would consist in withdrawing the charge from the retorts a little sooner.

But let us inquire now whether the use of this method of lighting our streets and houses, even in the worst of the cases quoted, has the deleterious effects which have been ascribed to it; or, rather, whether a better purification, or an improved manufacture of that commodity—nay, whether its entire suppression would remove, or notably diminish, the evil complained of.

I think I may assume, without fear of contradiction, that when coal or gas is burnt in the open air, the products of combustion from either substance are practically the same. I mean that, whether coals are burnt in a grate, as in our houses, factories, and steamers, or in a furnace, as in our smelting works and foundries, the products of combustion are, in reality, identical with those resulting from the consumption of gas light.

The *Lancet*, than which there is, in my opinion, no publication that has rendered more essential service to the public, by calling their attention to the impurities of articles of general consumption in a masterly series of papers on that subject, and by whose endeavours many trading houses have been shamed into honesty or roused to a sense of responsibility—the *Lancet*, of the 17th of June last, estimates at about 300,000 the number of household chimneys belching forth coal smoke, which, early in the morning, gathers rapidly into a cloud denser and denser, so as to effectually intercept the vision of the observer, who climbs to the top of St. Paul's or of Highgate-hill for the purpose of inspecting the giant city after this fashion. "This coal smoke being, as it were, badly manufactured and unpurified gas, and being not only" (to use again the words of the writer in the *Lancet*) "*a stifling nuisance in itself, but a convenient medium for the suspension and retention of every other noxious exhalation*," does it not appear almost preposterous to inveigh against the use of gas as a deleterious agent of light, whilst we leave 300,000 household chimneys, and "*no end of factories*," belching forth crude and altogether unpurified gas, not only as poisonous as gas light, and stifling in itself, but keeping further in suspension among us, and preventing the dissipation of every volatile compound which can revolt the senses and engender disease?

The metropolis is, I believe, lighted by 22 establishments, which employ about 500,000 tons of coal to produce about 5,000,000 cubic feet of gas. But these 500,000 tons of coal yield back two-thirds of their weight, or say 300,000 tons of coke which are consumed in the establishments themselves, for the purpose of heating the gas retorts, or are sold to, and burnt in, other factories or private houses.

Now, the quantity of coals yearly imported in London is, I believe, about	4,000,000 tons
From which, if we deduct the quantity used for gas-making	500,000
There remains of coals	3,500,000
Do. of coke left after manufacturing the gas	300,000
Total of coals and coke consumed in London for household and factory purposes	3,800,000 tons

These figures show, I conceive, in a decided manner, that though gas-burning contributes, of course, to render the air we breathe impure, it is only *in a very small degree*, and that even suppressing gas light altogether would not purify the atmosphere to a much greater extent than the stopping of six of the 130 sewers which discharge their loathsome contents in the Thames would purify that noble river.

Indeed, if we want to free the atmosphere from the products of combustion, it is not gas, but household fires that should be extinguished. As to our factories, they should evidently be demolished, never again to be rebuilt; our steamers should be cast aside, never again to be permitted to ply on the Thames; and this, if carried into operation, would clearly supersede all the decrees of the Legislature for the abatement of the smoke nuisance.

With respect to the discomfort which is experienced by some persons from the use of gas in apartments, and also to the damage which is caused to books, pictures, articles of furniture, &c., from the same cause, it is useless, I am afraid, to look for a remedy in a greater care in the manufacture of gas, or in improvements in its purification—improvements which, besides, are as yet in the womb of time. But why should not those who are annoyed by this state of things, and who choose, or are, as it were, compelled to burn gas, wait for these, as yet, unattainable remedies, or undiscovered improvements, when, by ordering from their gasfitter the apparatus of the illustrious Faraday, for conveying the products of the combustion of gas into the chimney-flue, they can entirely and at once get rid of the nuisance altogether?

A. NORMANDY.

67, Judd-street, Brunswick-square, July 26, 1854.

A TABLE OF GAUGES,

Exhibiting the Value of each Division upon the various GAUGES *used in the* METAL TRADES, *in parts of an inch; showing also the Division upon any Gauge corresponding with a given Division upon any other Gauge, or their relation to each other.*

Value in Decimals of an Inch.	Value in Common Fractions of an Inch.	Value in French Millimetres.	Birmingham Wire Gauge, for Iron Wire, Sheet Iron, and Steel.	Weight of a Superficial Foot of Sheet Iron.	Lancashire Wire Gauge, for Round Steel Wire and Pinions.	Birmingham Metal Gauge, for Sheet Metals, Brass, &c.	Sheet Copper.	Sheet Zinc.
In.	In.	M.M.	No.	lb.	No.	No.	lb.	No.
·004	..	..	36	..	..	1	..	—
·005	..	..	35	..	..	2	..	—
·007	..	..	34	..	..	..	..	—
·008	..	..	33	..	..	3	..	—
·009	..	..	32	..	..	..	..	—
·010	..	..	31	..	..	4	..	—
·011	..	..	..	..	..	..	4	6
·012	..	..	30	..	..	5	..	—
·013	..	..	29	..	80	6	..	7
·014	..	..	28	..	79	..	5	—
·015	1/64	..	..	.	78	7	..	8
·016	..	..	27	..	77	8	6	—
·017	..	..	..	..	..	..	..	9
·018	..	..	26	·78	76	..	..	—
·019	..	·5	..	..	75	9	7	—
·020	..	..	25	·84	..	..	..	—
·022	..	..	24	·95	74	..	8	10
·023	..	..	..	..	73	..	..	—
·024	..	..	..	..	72	10	..	—
·025	..	..	23	·99	..	..	9	—
·026	..	..	..	..	71	..	..	—
·027	..	..	..	..	70	..	..	11
·028	..	..	22	1·15	..	..	10	—
·029	..	..	..	..	69	11	..	—
·030	..	..	..	..	68	..	..	12
·031	1/32	..	..	..	67	..	11	—
·032	..	..	21	1·32	66	..	..	—
·033	..	..	..	..	65	..	12	—
·034	..	..	..	..	64	12	..	—
·035	..	..	20	1·41	63	..	13	13
·036	..	..	..	..	62	13	..	—
·038	..	..	..	..	61	..	14	—
·039	..	1·	..	..	60	..	..	—
·040	..	..	..	..	59	..	..	14
·041	..	..	..	..	58	14	15	—
·042	..	..	19	1·70	57	..	..	—
·044	..	..	..	..	56	..	16	—
·045	..	..	..	..	..	..	..	15
·046	..	..	..	..	..	..	17	—
·047	3/64	..	..	..	..	15	..	—
·049	..	..	18	1·92	..	..	..	—
·050	..	..	..	..	55	..	18	16
·051	..	..	..	..	..	16	..	—
·052	..	..	..	..	..	..	19	—
·055	..	..	..	..	54	..	20	17
·057	..	..	..	..	..	17	21	—
·058	..	1·5	17	2·19	53	..	..	—
·060	..	..	..	..	52	..	22	18
·061	..	..	..	..	..	18	..	—
·062	1/16	..	..	2·50	..	..	23	—
·064	..	..	..	..	51	19	..	—
·065	..	..	16	2·62	..	..	24	19
·067	..	..	..	..	50	20	..	—
·068	..	..	..	..	..	..	25	—
·070	..	..	..	..	49	..	..	20
·071	..	..	..	..	..	..	26	—
·072	..	..	15	2·97	..	21	..	—
·073	..	..	..	..	48	..	..	—
·074	..	..	..	..	..	22	27	—
·075	..	..	..	..	..	..	..	—
·076	..	..	..	..	47	..	..	—
·077	..	..	..	..	..	23	28	—
·078	5/64	2·	..	..	46	..	.	—
·080	..	..	..	..	45	..	..	—
·082	..	..	..	..	..	24	30	—
·083	..	..	14	3·23	..	..	..	—
·084	..	..	..	..	44	..	..	—
·085	..	..	..	..	..	..	..	—
·086	..	..	..	..	43	..	..	—
·091	..	..	..	..	42	..	..	—
·094	3/32	..	..	..	..	..	..	—

A TABLE OF GAUGES—(*continued*).

Value in Decimals of an Inch.	Value in Common Fractions of an Inch.	Value in French Millimetres.	Birmingham Wire Gauge, for Iron Wire, sheet Iron, and Steel.	Weight of a Superficial Foot of Sheet Iron.	Lancashire Wire Gauge, for Round Steel Wire and Pinions.	Birmingham Metal Gauge, for Sheet Metals, Brass, &c.	Sheet Copper.	Sheet Zinc.
In.	In.	M.M.	No.	lb.	No.	No.	lb.	No.
·095	..	..	13	3·64	41	25	..	—
·096	..	..	..	..	40	..	..	—
·098	..	2·5	..	..	39	..	36	—
·100	..	..	..	..	38	..	..	—
·102	..	..	..	..	37	..	..	—
·103	..	..	..	..	..	26	..	—
·105	..	..	..	..	36	..	..	—
·107	..	..	..	..	35	..	..	—
·109	$\frac{7}{64}$	..	12	4·30	34	..	..	—
·111	..	..	..	..	33	..	..	—
·113	..	..	..	..	..	27	..	—
·115	..	..	..	..	32	..	..	—
·118	..	3·	..	..	31	..	..	—
·120	..	..	11	4·73	..	28	42	—
·124	..	..	..	..	..	29	..	—
·125	$\frac{1}{8}$	..	..	5·00	30	..	..	—
·126	..	..	..	..	..	30	..	—
·130	..	..	..	..	..	..	..	—
·133	..	..	..	..	..	31	..	—
·134	..	..	10	5·50	29	..	50	—
·138	..	3·5	..	..	28	..	..	—
·140	$\frac{9}{64}$	..	..	..	..	..	..	—
·141	..	..	..	..	27	..	..	—
·143	..	..	..	..	26	32	..	—
·145	..	..	..	..	..	33	..	—
·146	..	..	..	..	25	..	..	—
·148	..	..	9	6·29	24	34	56	—
·150	..	..	..	..	23	..	..	—
·152	..	..	..	..	22	..	..	—
·156	$\frac{5}{32}$	..	..	..	..	..	..	—
·157	..	4·	..	..	21	..	..	—
·158	..	..	..	..	..	35	..	—
·160	..	..	..	..	20	..	..	—
·164	..	..	..	..	19	..	..	—
·165	..	..	8	6·64	..	..	62	—
·167	..	..	..	..	18	36	..	—
·169	..	..	..	..	17	..	..	—
·172	$\frac{11}{64}$	..	..	..	..	..	..	—
·174	..	..	..	..	16	..	..	—
·175	..	..	..	..	15	..	..	—
·177	..	4·5	..	..	14	..	..	—
·180	..	..	7	7·45	13	..	70	—
·185	..	..	..	..	12	..	..	—
·187	$\frac{3}{16}$	..	..	7·50	..	..	..	—
·189	..	..	..	..	11	..	..	—
·190	..	..	..	..	10	..	..	—
·191	..	..	..	..	9	..	..	—
·192	..	..	..	..	8	..	..	—
·195	..	5·	..	..	7	..	..	—
·198	..	..	..	..	6	..	..	—
·201	..	..	..	..	5	..	..	—
·203	$\frac{13}{64}$	..	6	8·34	..	..	76	—
·204	..	..	..	..	4	..	..	—
·205	..	..	..	..	..	..	..	—
·209	..	..	..	..	3	..	..	—
·219	$\frac{7}{32}$	5·5	..	..	2	..	..	—
·220	..	..	5	8·66	..	..	84	—
·227	..	..	..	..	1	..	..	—
·234	$\frac{15}{64}$	..	..	..	A	..	..	—
·236	..	6·	..	..	..	..	..	—
·238	..	..	4	9·55	B	..	..	—
·242	..	..	..	..	C	..	..	—
·246	..	..	..	..	D	..	..	—
·250	$\frac{1}{4}$	..	..	10·00	E	..	..	—
·257	..	6·5	..	..	F	..	..	—
·259	..	..	3	10·45	..	..	..	—
·260	..	..	..	..	..	..	..	—
·261	..	..	..	..	G	..	..	—
·265	$\frac{17}{64}$	..	..	..	..	..	..	—
·266	..	..	..	..	H	..	..	—
·270	..	..	..	..	..	..	..	—
·272	..	..	..	..	I	..	..	—
·277	..	7·	..	..	J	..	..	—
·281	$\frac{9}{32}$	..	..	..	K	..	..	—
·283	..	..	..	..	..	..	..	—
·284	..	..	2	11·25	..	..	..	—
·290	..	..	..	..	L	..	..	—
·295	..	7·5	..	..	M	..	..	—

A TABLE OF GAUGES—(*continued*).

Value in Decimals of an Inch.	Value in Common Fractions of an Inch.	Value in French Millimetres.	Birmingham Wire Gauge, for Iron Wire, Sheet Iron, and Steel.	Weight of a Superficial Foot of Sheet Iron.	Lancashire Wire Gauge, for Round Steel Wire and Pinions.	Birmingham Metal Gauge, for Sheet Metals, Brass, &c.	Sheet Copper.	Sheet Zinc.
In.	In.	M.M.	No.	lb.	No.	No.	lb.	No.
·300	$\frac{19}{64}$	..	1	12·45	..	..	..	—
·302	..	..	..	..	N	..	..	—
·308	..	..	..	..	..	..	..	—
·312	$\frac{5}{16}$	8·	..	12·50	..	..	..	—
·316	..	..	..	..	O	..	..	—
·320	..	..	..	..	..	..	..	—
·323	..	..	..	..	P	..	..	—
·328	..	..	..	..	..	..	..	—
·330	$\frac{21}{64}$	..	..	..	..	..	..	—
·332	..	..	..	..	Q	..	..	—
·335	..	8·5	..	..	..	..	..	—
·339	..	..	..	..	R	..	..	—
·340	..	..	0	..	..	..	..	—
·344	$\frac{11}{32}$	..	..	..	..	..	..	—
·348	..	..	..	..	S	..	..	—
·356	..	..	..	..	..	..	..	—
·358	..	9·	..	..	T	..	..	—
·360	$\frac{23}{64}$	..	..	..	..	..	..	—
·365	..	..	..	..	..	..	..	—
·368	..	..	..	..	U	..	..	—
·375	$\frac{3}{8}$	9·5	..	15·00	..	..	..	—
·377	..	..	..	..	V	..	..	—
·380	..	..	00	..	..	..	..	—
·386	..	..	..	..	W	..	..	—
·390	$\frac{25}{64}$	..	..	..	..	..	..	—
·395	..	10·	..	..	..	..	..	—
·397	..	..	..	..	X	..	..	—
·404	..	..	..	..	Y	..	..	—
·406	$\frac{13}{32}$	..	..	..	..	..	..	—
·410	..	..	..	..	..	..	..	—
·413	..	..	..	..	Z	..	..	—
·420	..	..	..	..	A 1	..	..	—
·422	$\frac{27}{64}$	..	..	..	..	..	..	—
·425	..	..	000	..	..	..	..	—
·431	..	11·	..	..	B 1	..	..	—
·437	$\frac{7}{16}$	..	..	17·50	..	..	..	—
·440	..	..	..	..	..	..	..	—
·443	..	..	..	..	C 1	..	..	—
·452	..	..	..	..	D 1	..	..	—
·454	$\frac{29}{64}$	..	0000	..	..	..	..	—
·455	..	..	..	..	..	..	..	—
·462	..	..	..	..	E 1	..	..	—
·469	$\frac{15}{32}$	..	..	..	..	..	..	—
·470	..	..	..	..	..	..	..	—
·475	..	..	..	..	F 1	..	..	—
·484	..	..	..	..	G 1	..	..	—
·485	..	..	..	..	..	..	..	—
·494	..	..	..	..	H 1	..	..	—
·500	$\frac{1}{2}$	..	..	22·00	..	..	..	—
·562	$\frac{9}{16}$	..	..	22·50	..	..	..	—
·625	$\frac{5}{8}$	..	..	25·00	..	..	..	—
·750	$\frac{3}{4}$	..	..	30·00	..	..	..	—
·875	$\frac{7}{8}$	..	..	35·00	..	..	..	—
1·000	1	25·39	..	40·00	..	..	..	—

To render this table more intelligible to those unused to decimals, it should be observed that the *first* figure after the dot denotes tenths of an inch—the *second*, hundredths of an inch or tenths of a tenth—the *third*, thousands of an inch, or tenths of a hundredth, or hundredths of a tenth; or, *collectively*, they express thousandth parts of an inch in units, tens, and hundreds, *e. g.*, ·225 is 225 thousandths of an inch, or 2 tenths, 2 hundredths, and 5 thousandths of an inch, or $2\frac{1}{4}$ tenths of an inch.

Correspondence.

THE SUGAR TEST FOR SULPHURIC ACID.

SIR,—It has been suggested to me that the usual sugar test for sulphuric acid might be of some use in determining whether oil of vitriol is ever produced by the combustion of coal gas; but I find it quite useless for such a purpose. On evaporating carefully a pure and weak solution of *sulphurous* acid in distilled water until but a few drops remain, exactly the same reaction ensues with sugar as if the fluid had contained oil of vitriol. The result is, consequently, fallacious. Two chemists of eminence, on repeating the same experiment, have arrived at the same conclusion as myself.

The sulphurous acid gas, before reaching the distilled water, was made to traverse a tube filled with fragments of carbonate of byrata slightly moistened; it was, consequently, quite free from sulphuric acid. L. THOMPSON.

London, Aug. 9, 1854.

KIRKHAM'S WATER GAS.

SIR,—Allusion has been made, in recent numbers of your JOURNAL, to an experiment about to be tried upon the manufacture of water gas on Mr. Kirkham's system, for the lighting of the Hospital of the *Invalides*. I have just been informed that the experiment has been forbidden by the Minister of War, upon a report made by M. Pelouze, one of our most distinguished chemists, setting forth the danger to the lives of the inmates, in the event of the escape of a gas containing a large proportion of carbonic oxide, which is well known to be a most deadly poisonous gas. M.

Paris, Aug. 7, 1854.

RECTIFICATION OF AN ANDERSONIAN "FACT."

SIR,—I delivered a speech a short time ago, which was reported in your last month's impression, wherein I stated that the Phœnix Gas Company had been some time without a dividend, but that recently they had paid 2½ per cent., while borrowing from their reserve fund.

I am informed by the secretary of the Phœnix Company that they have never been without a dividend—that it is now 3½ per cent.; and, such a statement being hurtful to them, I am requested to correct it. This I cheerfully do, and regret that the impression on my mind at that time should not have been consistent with this information.

Your insertion of the above will oblige yours, &c.,

GEO. ANDERSON.

Surrey Consumers' Gas Works, London, July 24, 1854.

Register of New Patents.

EDMUND JULES MAUMENÉ, of Rheims, professor of chemistry, for "*Improvements in the treatment of lignite, or white coal; and in obtaining useful products therefrom.*" Patent dated Oct. 12, 1853.

The patentee thus describes his invention:—I carbonise or distil the lignite or white coal in a retort, and I collect the volatile products, which consist principally of a thick yellow hazy liquid ammonia and hydro-cyanite, and other salts of ammonia. A quantity of combustible gas is given off, and may be burned under the retort, or used for heating other vessels, or for other purposes. A current of ordinary or overheated steam may be introduced into the retort during the process of distillation or carbonisation.

Carbonised lignite is generally reduced to a friable or powdery state by carbonisation, and it is then washed in dilute muriatic acid, capable of dissolving the oxide or sulphuret of iron, or other impurities contained in the lignite. It is afterwards washed with water to remove the acid, and dried and ground to a fine powder. The powder so prepared forms a black pigment, which may be used with oil for varnish, for printers' ink, or other purposes. Various shades of black may be obtained by calcining this powder with potash or soda, or an alkaline salt; or by cleansing the lignite in the first instance with the alkali or alkaline salt, and afterwards washing it with water or dilute acid, or with both in succession.

The substance thus obtained is also applicable, in lieu of animal charcoal, for decolorising solutions of sugar or other solutions.

In some cases he calcines it with other suitable materials, such as refuse wool, tartar, or sawdust, in or to increase or facilitate its decolorising effect.

He also prepares an artificial fuel, by mixing the carbonised lignite (either in its raw state, or after purification by acid) with a tarry liquid obtained in the distillation of the lignite, or with other tar. The mixture is made into bricks or blocks, and again carbonised. By distilling a yellow tarry liquid, he obtains an oil, which is again rectified by distillation. This oil possesses some of the properties of the oils obtained by the distillation of coal-tar, without having the same disagreeable odour. This oil may be employed, either alone or mixed with turpentine, benzole, alcohol, or other suitable liquids, for dissolving caoutchouc, gutta percha, resinous or fatty matters, and other substances suitable for cleaning cloth or burning in lamps.

Naphthaline, para-naphthaline, eupione, and other products, are also obtained in the distillation of the aforesaid tar liquid, and collected by any of the known processes for that purpose, or may be employed in the manufacture of candles.

The patentee claims for the manufacture, from lignite, of a black pigment, substances for decolorising solutions of sugar, artificial fuel, volatile oil, and naphthaline, and similar products, without the disagreeable odour possessed by similar products manufactured from coal-tar.

JEAN FRANCOIS FELIX CHALLETON, of Paris, for "*Certain improvements in carbonising and distilling peat, coal, wood, and other animal, vegetable, and mineral substances.*" Patent dated Oct 21, 1853.

The invention consists of a furnace in which the carbonisation and distillation of animal and vegetable matters is effected so as to extract the gaseous oils, resinous and ammoniacal substances, acetic acid, and other matters contained in them, and also to purify the gases produced by carbonisation.

The furnace is constructed of fire-bricks, and contains in its interior space a metallic retort. At its extremity the space between the internal retort and the furnace is filled up with brickwork of some inches thickness; immediately after it there is an empty space round the retort corresponding in area to the draught chimney, which is built over the space. This space is separated from the remaining portion of the furnace by a partition of fire-bricks, which is perforated in a regular manner all round the retort. These holes are for equalising the draught in the whole furnace. The extremity of the furnace is also closed by a wall of perforated fire-bricks, for regulating the quantity of air admitted. On one of the external side walls of the furnace are fixed the bearings of several hand or fly wheels, whose shafts pass through the wall, to carry each inside the furnace, a spur-wheel to a rack attached to a carriage, which can be moved backwards and forwards inside the retort. Along the side walls are fixed pipes to take off the gas and vapours produced. These pipes communicate with the inside by means of branch pipes passing through the walls. The upper portion of the furnace is perforated with apertures, through which the pipes pass for the exit of the volatile matters produced by carbonisation.

The lower portion of the furnace consists of the hearth, whose sole or bottom, and sides, are formed of bricks. This hearth is partly covered over by the bottom of the retort, and communicates on each side with the space left between the retort and the side and top walls of the furnace, in such a manner that the retort is completely enveloped in the flames.

Below the hearth there are two conducting pipes, which communicate with it by means of distributing branch pipes, arranged in a convenient manner so as to distribute the gas which is taken from the gasometer, filled with the products of carbonisation. Under the bars of the furnace runs a flue, communicating with the outside by means of doors, for introducing the fuel, and withdrawing the ashes which might hinder combustion.

In the interior of the furnace is fixed a retort, whose bottom is slightly inclined, and which is divided into compartments that can be shut off from each other by sliding-doors. On the top of the retort there are openings for the pipes which let off the products of distillation and carbonisation. The upper part of the retort has also troughs running along the slots for the sliding-doors, which troughs receive the parallel flanges branching off the body of the door at its upper portion. One of the sides of the retort is perforated in each compartment, so as to admit the shaft in the wall by which the carriage is driven. The lower portion of the furnace rests on wrought-iron stands, to which the sole-plate of the furnace is firmly fixed. The sole-plate carries a line of rails, which is broken at each sliding-door, and on which rolls the carriage. One or more compartments are left outside the door, for the purpose of extinguishing in them the matter under treatment. This extinguishing process is effected by a jet of alkaline vapour, which is introduced in the extinguishing chamber, and serves to condense the sulphurous gas which may be present in the coal, for the purpose of thus purifying and deodorising the latter.

The separating doors of the retort slide on grooves. At their upper portion they are formed into T-like flanges, which are luted into the troughs on the top of the retort. The doors are raised by means of hoists or winches.

The carriage consists of a truck or waggon, rolling on wheels made of metal or fire-clay. The box of this truck is made of wrought iron, and contains the matter which is to be carbonised or distilled. The rack is fixed in one of the sides of the truck, so as to gear into the spur-wheels, by means of which the carriage is made to move from one compartment to the other. There is to each extremity of the truck a flap-door, hinged horizontally, for facilitating the loading and unloading of the truck whilst the carbonising process is being carried on.

Each compartment contains a waggon. These waggons are shifted forwards progressively; and, as they travel in a direction opposite to that of the heat, they pass successively from a low temperature to a higher one, until the carbonisation is completed, upon which the waggon is drawn into the extinguishing chamber, being assisted in its progress by a slight inclination in the sole of the furnace.

The patentee claims for these arrangements.

MICHEL HENRI PERODEAUD, civil engineer, of the Rue Godot de Mauroy, Paris, for "*An improved mode of treating peat, for the conversion of the same into an artificial coal, which may be used in that state, or afterwards reduced to coke.*" Patent dated Nov. 6, 1853.

By this invention, the peat is submitted to the action of a pugmill, which brings it into a state of minute division; and, while undergoing this operation, certain chemical solutions are mixed therewith for the purpose of eliminating the metallic and other bodies which it may contain, and leaving the carbon intact.

The solutions which he employs, and which he calls "alkaline solutions," are prepared separately as follows:—The first solution (A)—caustic soda and potash, at 40° Beaumé, mixed in the proportion of an equal half part of each alkali; of this compound take one part; water, 30 parts; sulphate of potash and alumina, 32. The sulphate made previously is dissolved in the hot state in the proportion of ten quarts of water to 2 lb. of the salt, which will form altogether 30 quarts.

The second solution (B) is composed of nitric acid of commerce, at 36° Beaumé, 1 part; and water, 40 parts.

The third solution (C) is hydro-chloric acid (muriatic acid of commerce) at 22° Beaumé, 5 parts; water, 86 parts; tribasic sulphate of potash and alumina, 2 parts. The sulphate is to be dissolved as described for the first solution, and forming altogether 20 quarts.

These solutions are to be introduced into the peat indifferently, in the proportion of 10 quarts of solution for every cubic yard of fresh peat. They will be found effectual in producing the desired effect upon dry peat; but when operating upon peat which is saturated with moisture, the formula of the solutions must be modified as follows:—For the first solution (A), take carbonate of potash and soda of commerce, 1 part, dissolved with heat in twelve times its weight of water; hypo-chloride of lime (chloride of lime of commerce), 1 part; tribasic sulphate of potash and alumina, 3 parts,

dissolved with heat in the proportion of 10 quarts of water for every 2 lb. of the salt, and forming altogether 30 quarts. Mix these solutions together, and the solution A will then be formed, consisting of 90 quarts of the above solution of carbonate and hydro-chlorite, and 30 quarts of the sulphate of potash and alumina. Nitrates of potash and soda, mixed with nitrate of lime (this latter in equal proportion with the nitrates of potash and soda), when dissolved in a cold state in twelve times their weight of water, might also be advantageously employed. The formula of the solution A would then be—90 quarts of the solution of the nitrates, and 30 quarts of the solution of potash and alumina.

The solution B, when the solution A is composed of carbonate of potash and soda, and hypo-chlorite of lime, should contain 1½ part of nitric acid; but it should be in the strength above indicated when the solution of nitrates is employed.

The proportion to be poured into the pugmill indifferently for the three solutions would be 20 quarts to every cubic yard of fresh peat—the solution A being modified, and the solution B having an additional quantity of acid.

Instead of liquid caustic soda and potash, at 40°, the solution A may be advantageously employed, when modified as described, by the carbonates and the hypo-chlorite; and also the solution B, having an additional quantity of acid, for dry peat or peat of good and middling quality.

When the solution A is employed, composed according to the second formula, the proportions of A and B should be 20 quarts for every cubic yard of fresh peat.

If it should be found, by analysis, that ferruginous compounds or compounds of manganese predominate in the peat to be operated upon, which impart to it a reddish hue somewhat resembling that of tobacco, it will be in that case advisable to augment by 50 per cent. the quantity of acid of the solution B, and to double the proportion of acid of the solution C. The solution B will then be—acid 1½ part, water 40 parts; and the solution C will be—hydrochloric acid 10 parts, water 86 parts, sulphate of potash and alumina (dissolved as above stated) 30 quarts. Although these kinds of peat are generally thrown away, as being of inferior quality, the patentee, by this process, considers that he is able to impart to them the same qualities as the superior kinds of peat possess, though of course the per centage of peat coal produced is less, as the elimination of the metallic bodies reduces materially the weight of the peat which remains.

The process which the patentee employs—taking the period of its duration as twenty minutes, and the quantity of peat to be operated upon as twenty yards—may be thus described:—The solution A is introduced into the pugmill with the first cubic yard of peat, and by anticipation for six cubic yards—that is to say, 60 quarts, or 120 quarts if the modified solution be employed. After the sixth cubic yard of peat has been introduced, the solution B may be applied in sufficient quantity for four cubic yards—that is to say, 40 quarts, or 80 quarts if the modified solution be employed. These first 10 cubic yards having been heated by the solutions A and B, the solution C must be applied by anticipation to the remaining 10 cubic yards—that is to say, 100 quarts, or 200 quarts if the modified solution be used. The receptacle into which the peat flows after being heated by the pugmill, must be of sufficient capacity to contain the 20 yards of fresh peat and the rendered liquid, which is poured in during the operation, so that the whole of the three alkaline acid solutions, successively introduced into the pugmills during that time, may be received in the same receptacle.

The principal object being to render soluble and eliminate the combinations of the ulmic acid with the metallic bases and metalloids, and to decompose the ulmates, the patentee's endeavour is to modify the chemical compositions of the peaty matter, by breaking up one of its compounds, whatever it may be; for when one constituent is modified or combined diversely in a body which contains several of them, the whole are instantaneously modified or broken up.

The principal feature of his process (and what he describes as the novelty of his invention) consists in neutralising as completely as possible, by the regular manufacturing operations, the acid principle contained in the peat or in various combinations. This object would be defeated if the proportions of acid were too considerably augmented. It is the action of acid, diluted to a suitable and ascertained extent, which it is advisable to obtain, and not the energetic disorganisation and oxygenising action, so to speak, of these powerful chemical agents. Thus it will be seen that the employment of the solutions in excess is not attended with any injurious result, except that it increases the expense without any benefit. An excess of acid in the proportions of the solutions would, however, produce an effect entirely contrary to that desired, as, instead of neutralising the acid principle, it would augment the number of combinations of that kind.

The peat, having been treated as described, is run out into reservoirs, formed by constructing on the ground, walls of wicker-work or willow, about three feet in height, and covered with some suitable filtering fabric. This fabric will permit the water contained in the peat to run off, whereby the deposit of the peat will be facilitated, and at the end of about five days the peat will have acquired a degree of consistency, so as to admit of its being cut up into pieces, and submitted to the action of a drying apparatus. When all the moisture has evaporated from the peat, it has become sufficiently solidified, and is then ready for use, and in that state the patentee designates it "peat coal." It may be converted into coke by any of the well-known processes.

The alternate employment of alkalies, of acids properly so called, and hydro-acids, constitutes the essential principle of the patentee's invention, independently of the mechanical action of the pugmill. He claims—

1. The employment, either directly or indirectly, in the treatment of peat, of alkali-acids, having oxygen for their base, and of hydro-acids.

2. The arrangement of apparatus for the purpose of operating upon the peat.

Joseph Wormald, of Vauxhall, and George Pollard, of York-road, Lambeth, for "*An improved pipe wrench.*" Patent dated Nov. 26, 1853.

The invention consists of a lever wrench for screwing pipes. The wrench is adjustable to pipes of different sizes by a moveable eye or link, which slides along the neck of the lever, and is fitted with springs and an eccentric tongue. The head of the lever is bent, or turned up, at an angle with the neck, and the inner face is made concave or V-shaped, and the surface toothed or grooved, for the purpose of increasing the bite or hold upon the pipe. Along the under side of the lever, from the head towards the shaft (where the moveable eye or link slides), there are a number of indentations or notches, forming a rack; and in the bottom of the collar of the said eye or link there is a tooth which fits into these notches and works along the rack. At the top of the said collar there is a spring which presses against the top of the lever and keeps the tooth up to the notch, and holds the eye or link in the required position when the instrument is in use. The opening in the collar is made larger in the back part than the neck of the lever, to admit of the tooth being relieved from one notch to another, which is done by pressing down the spring last mentioned, when the eye or link can be moved along the lever, backwards or forwards, at pleasure, so as to be adjusted to a pipe of any size within the capacity of the instrument. The eccentric tongue with which the moveable eye is fitted turns upon a pivot in the said eye or link, and projects in front thereof, and is held in the required position by means of a spring. The outer edge of the tongue is notched in a similar manner to the inside of the head of the lever. This tongue, by its eccentric motion, when power is applied to the lever, gives the grip or hold of the wrench upon the pipe, when turning the screw in the required direction, and at the same time allows the instrument to turn freely in the opposite direction, or slip round the pipe without turning the same.

The patentees claim the invention of the wrench described, with the eccentric tongue and double adjustment.

George Anderson, of the Gas Works, Rotherhithe, gas engineer, for "*Improvements in apparatus used when manufacturing gas, which apparatus, or part of which, is also applicable when transmitting gas from one place to another.*" Patent dated Dec. 17, 1853.

The improvements relate to the arrangement of apparatus for withdrawing gas from the retorts, or other generators employed in the manufacture of gas, in order to assist in relieving the pressure within those retorts or generators, and to force the gas generated to the purifying mains or other apparatus. The apparatus, so arranged, is also applicable when transmitting gas from one to a distant place.

Heretofore, various arrangements of apparatus (says the patentee) have been used to effect this object, some being of the rotary kind, and others of a reciprocating character; but when of the reciprocating description, it has been usual, in order to obtain uniformity of action, to employ several apparatus working in combination, and, in general, three have been employed, acting in succession by means of a three-crank shaft. The reciprocating machines employed for this purpose have been of two kinds—one formed by cylinders, with pistons working therein; and the other formed by inverted vessels, moving in liquid-like "gasholders"; but considerable friction, or other loss of power, has resulted from the use of either description of exhausting apparatus as heretofore arranged. The patentee's improvement consists in the employment of a single cylinder or chamber, with a piston moving therein at a comparatively high velocity—equal to that of a steam-engine—the cylinder or chamber being what is called "double-acting," that is, having an inlet or outlet valve, or sets of valves, at each end. He prefers that these valves should be arranged close at the ends of the cylinder or chamber, and that they should be self-acting, or acting alone by the vacuum created or the pressure exerted.

In working the exhausting apparatus of the reciprocating kind, as heretofore adopted, a very slow motion has been given to the piston; but the patentee has found that, by increasing the speed, and properly proportioning the length of the spoke, and the position of the valves for the passage of the gas, greater uniformity of action is obtained; and he has also found that from 70 to 150 spokes per minute answer well; but this speed may be increased, as the pressure against which the piston has to work is seldom more than equal to a column of water 3 feet high, or about equal to 1½ lb. pressure to the square inch of piston. In the movement of the piston the gas flows into the cylinder through one passage, and flows out through another—both passages being closed by valves. These valves, in order that they may be light and easily acted upon, are formed of leather or gutta percha, or any other suitable flexible material, which will not be injured to any great extent by the gas.

As the quantity of gas generated during any given time is always variable, and when that quantity is at any time below the average of supply, the tendency is to produce an undue amount of vacuum in the retorts, by which atmospheric air might be drawn in with the gas, it is usual to employ some compensating means by which the supply of gas to the exhauster may be rendered uniform. For this purpose the patentee employs a regulator, connected by pipes with the passage leading to and from the exhauster, and so arranged that when, by the diminution of the gas generated, the exhauster tends to create a vacuum in the retorts or generators, a conical valve at the bottom is forced open by atmospheric pressure, and readmits some of the gas which had been passed through the exhauster, thus equalising the pressure of gas in its passage to the exhauster, and securing great freedom of the parts and simplicity of action, by maintaining only one axis of motion.

The inventor claims the mode of arranging and combining and working the apparatus described, when employed in the manufacture of gas, and also when employed in transmitting gas from one place to another.

JOHN PARKINSON, of Bury, Lancashire, brass founder, for "*Improvements in governors for regulating the pressure of steam, gas, and other fluids or liquids.*" Patent dated Dec. 28, 1853.

The invention consists, first, in the application of a double compensating valve, acted upon by a flexible diaphragm or other equivalent agent, for regulating the pressure of gas, &c.; and, secondly, in an improved combination of parts for regulating the pressure of steam and other fluids or liquids, consisting of a double compensating valve and flexible diaphragm—the latter being protected from the action of the steam and other fluid or liquid, by a column of water. These combinations are described in drawings attached to the specification. The patentee claims—

1. The application of a double compensating valve, acted upon by a flexible diaphragm or other equivalent agent, for regulating the pressure of gas.

2. The improved combination of parts for regulating the pressure of steam and other liquids or fluids.

WALTER WATSON, of the Ardwick Iron Works, Manchester, for "*Improvements in machines used for rivetting together metallic plates.*" Patent dated Dec. 30, 1853.

The features of this invention may be best gathered from the patentee's claims, which are as follows:—

1. An arrangement for machines of ordinary action, wherein the rivetting ram is actuated direct from an eccentric or cam.

2. The method by which the ram or die for rivetting is made by the use of buffer or other powerful springs, to give way after a certain fixed pressure has been put upon the rivet.

3. The method by which a pressure may be put upon the plates to be rivetted together, by the use of a buffer or other powerful spring; and he claims also the use of a spring, or flexible arrangement, where the pressure is put on the plates by an independent action.

4. The arrangement by which the pressure is effected on the rivet and on the plates by direct-acting pistons and rods, actuated by steam or other motive power.

5. The arrangement combining double action (putting both heads on the rivets, or short lengths of metal used for rivets), and the effecting of a pressure on the plates.

JAMES SLATER, of Salford, mechanic, for "*Improvements in cocks, taps, or valves.*" Patent dated Dec. 31, 1853.

The improvements consist—first, in the construction of the cocks, taps, or valves; and, secondly, in the method of working them. At any convenient part within the bore or passage of the cock or tap, and before the entrance to the valve, is formed a chamber of larger diameter or dimensions than the said bore or passage. Upon one edge or side of this chamber is formed a seat or bed, having a valve fitted into or upon it, which valve is withdrawn from the said seat or bed, and thereby opened, or is pressed against it and closed, by means of an eccentric or cranked stud or pin fixed to the end of, or forming part of, the spindle by which the valve is opened or shut as required, and which eccentric stud or pin moves in a slit or groove formed in the top or head of the valve. Where valves are required to be kept open at "a dead lock," or opened at different or changeable areas, they may be worked by a worm-wheel and worm, or other description of mechanism, and they may be simply opened and closed by a hand lever. This chamber in the bore or passage of cocks or taps obviates any obstruction to the passage of whatever fluids may be required to pass through, and also provides an area equal to the delivery. The eccentric motion is applicable to all valves having or requiring a reciprocating motion. The inventor claims—

1. The adaptation or construction of a chamber situated before the entrance to the valves in cocks, taps, or valves—such chamber being larger in diameter than the bore of the valve.

2. The use or employment of an eccentric or crank for opening and closing valves, as well as a worm and wheel, or quadrant, as described.

JOHN H. JOHNSON, 47, Lincoln's-inn-fields, in the county of Middlesex, and of Glasgow, gentleman, for "*Improvements in the manufacture or production of gas, and in the application of materials employed therein.*" (Communicated by André Koechlin, Joseph Vicomte Duchatel, and Joseph Antoine Auguste de Perpigna, foreigners.) Patent dated Jan. 30, 1854.

This invention relates to the employment of certain substances in the manufacture of gas, not hitherto used for that purpose, and consists in the production of gas, either for lighting or heating purposes, from turf, wood, tar, and the waste and refuse of various vegetable substances, such as cotton, paper, chips, and sawdust. For effecting the production of gas from turf, the inventor says it is merely necessary to place the dry turf in a gas retort, and heat it to a red heat; but this gas has very slight illuminating properties, it burns with an almost entirely blue flame, and is altogether totally inapplicable to lighting purposes, whether public or private. Various means have been adopted for carburetting this gas which have hitherto been found inapplicable in practice, either on account of their inefficiency or the expense attending the process. The obviation of these difficulties forms one of the main features of the present invention. The operations, which, if effected at one time, can never be satisfactory, are divided into two distinct processes. By this means the carburetting of the turf or peat may be conducted so as to produce the best result, both as regards the quantity and quality of fuel; whilst, at the same time, the mixture of an inferior material (oxide of carbon) with the gas, for lighting purposes, is avoided. The decomposition of the essential oil of turf or peat is effected, not so much by the superheating of the oils themselves (for which, by their nature, they are not adapted), but by causing their vapours to make a long circuit through pipes or vessels heated to a temperature sufficiently great to effect their decomposition and conversion into gas. It is proposed either to mix the gases thus produced by the two operations, so as to obtain a moderate lighting power, or to employ them separately—the first for heating, and the second for illuminating purposes.

The same processes are equally applicable to the conversion of coal-tar into gas. This decomposition or conversion into gas is effected by causing the tar to pass, in a state of vapour, through the heated passages before referred to; but it is necessary in this case to use particular care, on account of the peculiar chemical nature of the material under treatment. The tar obtained from gas works is a composition of fine or well-divided coal, agglomerated by essential oils, more or less heavy, or more or less volatile. The tar is caused to pass directly over heated surfaces. The essential oils are decomposed, and the coal, freed from this species of cement which held it together, resumes its state of impalpable tenuity, and is drawn by the current of gas into the pipes, which become eventually obstructed thereby, and the operation will consequently be stopped by reason of the great deposit of coal dust in the pipes. This difficulty is easily obviated by introducing the gas (as free from water as possible) into a still or sheet-iron retort, similar to those at present employed in the preparation of coal oils. The process of distillation effects the separation of the vapours of the oil which disengage themselves, and of the coal which rests in the retort—the latter forming a product known as dry resin, which may be employed as fuel. On leaving the retort, the vapours of the oil are passed over a heated surface, as before described. In passing along these heated surfaces, the vapours are converted into gas by the action of the heat; and, as the particles of coal have been previously separated or removed, the obstruction to the pipes will be avoided.

The roof of the retort which the patentee employs for the carbonisation of the turf is composed of cast iron, and may be either of a circular or elliptical form. Internal flanges, cast upon the roof, support the bottom of the retort, which is composed of fire-clay tiles, luted with clay to each other and to the retort; and the waste or refuse of the coal which results from the operation, will complete the luting, and effectually prevent any escape or leakage. Lugs are also cast upon the roof, and situated outside the fire-clay brickwork. These lugs are united by transverse tie-rods or bolts, which maintain the proper width of the retort, and serve to strengthen and bind together the brickwork at the same time. The peculiar advantages of this compound retort of fire-clay and cast iron are, that the fire-clay bottom of the retort resists, better than the iron, the high temperature attained at the end of the operation; and, as its expansion is allowed, it is not exposed to the fractures to which retorts composed entirely of fire-clay are liable. The same liberty of contraction and expansion enables also the cast-iron portion of the retort to resist the destructive changes of temperature, and permits the heat from the fire-bricks to enter the interior of the retort. This retort is placed on a furnace which is so arranged, by aid of flues, that the whole surface of it may be equally heated. The retort is connected with an ordinary retort-head, fitted with pipes for the disengagement of the vapours. The vapours enter a refrigerator, which may be either of the form of a worm, or, still better, of the air-condenser generally employed. In this condenser is effected the condensation of the ammoniacal waters and the oils, which have collected separately. The non-condensable gas will pass off to the gasometer, previously traversing through lime purifiers.

The apparatus for the conversion of volatile oils into gas consists of a cast or wrought iron cylinder, which is partially filled with fragments of carbonised turf. This cylinder receives the volatile oils by a syphon pipe, which is supplied by another pipe, communicating with an upper reservoir or vessel, and fitted with a cock, by means of which the flow of oil may be regulated. The entire apparatus is placed on a furnace, and heated equally over its whole surface. As fast as the oil enters the cylinder, it is evaporated, and passes in a state of vapour to a pipe which communicates with a cast-iron retort, which is of the same length as the cylinder, and divided longitudinally into two distinct chambers by a partition, which is cast in one piece with the body of the retort, and extends from the front end of the same, to within a short distance of the other extremity, so as to afford a passage or communication from one chamber to the other, between the end of the retort and the end of the partition or diaphragm. By this arrangement the vapours of the oil enter near the end of the retort on one side, and pass along its entire length through an opening into a second chamber, and pass a second time along the entire length of the retort, before arriving at the exit-pipe situated at the head. Thus the vapours have to traverse nearly three times the length of the apparatus, and are subjected in their passage to a heat sufficiently great to cause the required decomposition. A similar pipe, fitted to the under side of the retort-head, allows of the withdrawal of the non-vaporised oil, or the vapours which may have condensed in the exit-pipe. The oil thus drawn off is replaced in the upper reservoir, or supply vessel, and again passed through the apparatus. The pipe communicates by a dip-pipe—as in the ordinary arrangements of a gas apparatus—with a receiving cylinder, partially filled with water. From this cylinder the gas passes into the condenser, which effects the separation of any particles of oil which may not have been decomposed. This oil is also conveyed to the supply reservoir or tank, to be again passed through the apparatus. From the condenser the gas passes into the lime purifiers, and thence to the gasometer, where it is mixed with the gas produced from the carbonisation of the turf. This gas the patentee employs also for heating, thus dispensing with the fuel hitherto used.

In order to render this gas sufficiently powerful as an illuminator, only 10 or 15 per cent. of the oil is required; and, as the retort supplies 20 or 30 per cent., it follows that there will be a considerable quantity remaining which may be rendered very profitable. The patentee proposes to make the following products from the surplus oil:—

1. A liquid almost free from odour, suitable for burning in lamps, or for the manufacture of hard varnish.
2. Grease for lubricating railway carriages, and other wheels.
3. Hard soaps for the toilet, and other purposes.
4. A thin oil of fine quality, suitable for lubricating the most delicate mechanism.

These products are obtained in the following way:—The raw or unprepared oil is first treated with one-tenth its weight of sulphuric acid, diluted in four times its weight of water, for the purpose of destroying the ammoniacal combinations contained in the oil, and converting into soluble sulphate the ammonia which would be otherwise lost. After resting for some hours, the oil is separated from the acid waters, and subjected to distillation by the aid of a current of steam of the temperature of 120°, which is supplied by a boiler working at the pressure of two atmospheres. The steam takes with it in a worm the oil, from which is extracted a product useful for the manufacture of varnish, whilst the residue serves to form the fatty matters referred to. The light essences, separated from the water by their density alone, are agitated, and mixed carefully with one-tenth their weight of concentrated sulphuric acid, destined to take up the naphthaline and bituminous products which have not hitherto been volatilised. A gentle heat of from 40° to 50° will assist the operation. After having agitated it for some hours, a mixture of 5 parts of peroxide of manganese and 100 parts of the essence is added, and the materials are again agitated and carefully mixed. When the bubbles of gas have ceased to disengage themselves, the mixture is left to rest for a day, and the essence floating on the surface is run off and agitated violently with half its volume of milk of lime (the essence being allowed to stand again), and again run off, requires an ordinary distillation to complete its manufacture. It is then perfectly colourless, has a very slight odour, which is not disagreeable, and may be used either for lighting purposes or the manufacture of varnish. It dissolves copal better than turpentine. For the manufacture of the other products, the oil which the steam has not carried off, and which remains in the still, is subjected for one or two hours to the action of a jet of steam, for the purpose of removing therefrom any remaining portion of the essence or naphthaline. After having separated them from the water, they are mixed with one-tenth of their weight of concentrated sulphuric acid. After agitating for two hours, sea salt is added in the proportion of 5 parts salt to 100 oil. This is well mixed, and then allowed to stand. The oil, which floats on the top, is then run off into another vessel, and washed twice with cold water, until the acid smell has been completely removed. This operation is for the purpose of removing the alkaline products, which are rendered soluble by the action of the acid. After another running off, which must be done with great care, the oil is again agitated with half its volume of a solution of caustic soda of 6° Cartier. It is then allowed to stand, and is run off again and distilled in a still with an iron worm, as copper would dissolve the fluid. By analysing the products of distillation, it will be found that, for 100 parts in weight of oil, the following results will be obtained:—35 parts of oil, No. 1, suitable for the manufacture of grease; 35 parts of oil, No. 2, for lubricating machinery; about 20 parts of a substance composed principally of paraffine, which assumes, when cooled, the consistency of butter, and will also serve for lubricating purposes; and 10 parts loss with the carbonaceous deposits in the still. The oils 1 and 2 have, at this stage, an acrid and strong bituminous odour, which will pass off by leaving them exposed to the air for some days in shallow vessels, at a temperature from 40° to 50°. The lubricating oils are then ready for use.

For converting oil No. 1 into grease, a copper boiler is employed, placed over the furnace, and fitted with an emptying cock. In this boiler is placed white tallow 50 parts, and a soda lye of 10° Cartier 115 parts. This mixture is gently heated and agitated, and, as the mass rises, 100 parts of water are added. When the thickening is finished, and the materials sufficiently reduced to a paste, 100 parts of the oil No. 1 are added. The whole is then raised to a boiling point again, and, by opening the discharge-cock, it is run into tubs or troughs, fitted with agitators, where, after continual agitation, it is allowed to cool. The grease thus prepared is particularly adapted for the lubrication of carriage wheels and heavy machinery.

From the oil No. 2 are manufactured hard soaps. For this purpose the soap is first prepared from white tallow or palm oil with caustic lyes of soda, and the thickening process is carried on in the ordinary manner. When this soap is nearly completed, 15 per cent. of oil No. 2 is added, such oil being saturated with ammonia, and agitated with 10 per cent. of its weight of soda lye. The process is effected in the usual manner. This soap has excellent cleaning properties, is susceptible of receiving all kinds of scents, and, from its softening and emollient qualities, is particularly applicable for the toilet.

The patentee claims—

1. For the extraction of gas from turf, peat, tar, and other articles before mentioned, by dividing a portion of two processes, whereby the inferior gas derived from the usual materials is obtained separately from the superior gas derived from the oils and essence also referred to, such gases being afterwards combined or used separately for lighting or heating purposes.

2. For a system or mode of decomposing the volatile oils by heating and vapours, and the application in particular of this process to the oils of turf and coal tar.

3. For the peculiar arrangement and construction of a retort, composed partly of fire-clay and cast iron.

4. For the arrangement of apparatus described for heating volatile oils by the action of heat; and

5. For obtaining the several products referred to from turf, oil, or residue, not employed in the production of gas.

Legal Intelligence.

COURT OF QUEEN'S BENCH.

WEDNESDAY, JUNE 28, 1854.

(Sittings in *Nisi Prius*, before Lord Chief Justice CAMPBELL and a Special Jury.)

YOUNG *v.* WHITE AND OTHERS.

This was an action brought for damages for the infringement of the plaintiffs' patent for the manufacture of paraffine and paraffine oil. The case excited considerable interest, both from its commercial importance and the great number of scientific witnesses that were expected to be called.

The ATTORNEY-GENERAL, Mr. BRAMWELL, Q.C., Mr. HINDMARSH, and Mr. WILLES, appeared for the plaintiffs; the defendants were represented by Mr. HUGH HILL, Q.C., Mr. GROVE, Q.C., Mr. WEBSTER, and Mr. ASPLAND.

In the course of the case which preceded,

Lord CAMPBELL inquired of the Attorney-General whether, if the case were proceeded with that day, there would be any probability of its being finished on the following evening, which would be the close of the sittings?

The ATTORNEY-GENERAL said that his case (for the plaintiffs) would not occupy his lordship long.

Mr. HILL said that the defendants' case would take a whole day, and he would not be responsible for its completion on the following evening. If the case should not be finished by the following evening (as the sittings ended then), both sides would be left in a worse position than if it were postponed to the next term. He had no objection to change the *venue* to London.

Lord CAMPBELL: I am very much afraid that there is an overflow of business in London as well as here. What do you propose that I should do? I will make any arrangement that will occasion the least inconvenience. If it could not be got through in a day, we had better not begin it. I am willing, however, to sit to-night. I can sit to-night, as far as my public duties are concerned, and I don't care how late I sit.

The ATTORNEY-GENERAL: We are in this unfortunate predicament. We have several witnesses here of the greatest importance to our case, who have come from Scotland. They are here voluntarily now, my lord; but if the trial were postponed——

Lord CAMPBELL: I dare say they would come voluntarily again; and I believe there is an act now passing through Parliament that will compel them to come.

The ATTORNEY-GENERAL: But they may come reluctantly, my lord.

Lord CAMPBELL: Surely, there can be no reluctance on the part of Scotchmen to come to London. (Laughter.)

The ATTORNEY-GENERAL: Perhaps some of your lordship's colleagues could sit?

Lord CAMPBELL: I don't know, as the law now stands, whether two courts of *nisi prius* can sit at the same time.

Mr. HILL: It has been decided that two courts of *nisi prius* cannot sit at the same time.

The ATTORNEY-GENERAL: I believe, as far as our case is concerned, that it will not last long. I don't think my case will last above an hour.

Mr. HILL: Well, I will leave the responsibility of it upon the Attorney-General, if the case does not finish before to-morrow night.

The ATTORNEY-GENERAL: I really don't see why it should not be finished to-morrow. My clients are so extremely anxious that the case should come on this term, that, if the case which is now on concludes within a reasonable time, your lordship might, perhaps, spare us an hour or so.

Lord CAMPBELL: I will do so with the greatest pleasure.

The case was commenced shortly after four o'clock.

Mr. HINDMARSH opened the pleadings. The plaintiffs were, James Young, Edward Meldrum, and Edward Wm. Binney; and Stephen White, James Miller, James Gibb, John Gibb, and Joseph Henry Reynell de Castro, were the defendants. The declaration stated that James Young, the plaintiff, was the first and true inventor of "improvements in the treatment of certain bituminous mineral substances, and in obtaining products therefrom," and had obtained her Majesty's letters patent for his invention; and that the defendants had infringed the said patent right. The defendants had pleaded—First, that the plaintiff was not the true and first inventor of the said alleged new manufacture in the said letters patent and declaration mentioned; secondly, that the said manufacture was not, at the time of making the said letters patent, a new invention within this realm; thirdly, that the specification does not particularly describe and ascertain the nature of the said invention, and in what manner the same is to be performed; and, fourthly, the defendants pleaded "Not guilty." Upon all four pleas, issue had been joined.

The ATTORNEY-GENERAL: Gentlemen of the jury, I appear before you in behalf of the plaintiff, Mr. Young, who is the patentee of an invention for obtaining paraffine oil, or paraffine, from bituminous coal. The plaintiff took out his patent on Oct. 17, 1850. The defendants carry on business in Manchester, and at Springfield-lane, Salford, as gas manufacturers and manufacturing chemists, under two patents for the manufacture of gas by what is called the "hydrocarbon process." Now, the history of the plaintiff's invention is this:—In the year 1847 he was applied to by Dr. Lyon Playfair, who is a connection of his, to analyse a certain mineral oil which had been found exuding in a certain coal-pit, at a place called Riddings, near Alfreton, in Derbyshire. This oil appeared to be of a very remarkable character, and it attracted considerable attention; and, as I have told you, Dr. Lyon Playfair was desirous of having it analysed by the plaintiff, who was a scientific person, with a view of ascertaining whether naphtha could be procured from it. The plaintiff accordingly analysed this oil. He was unable to obtain naphtha in any sufficient quantity; but by a further process he was enabled so to purify the oil as to obtain from it considerable illuminating power. He afterwards, by still further experiments upon it, discovered that it was capable of being applied to the purposes of illumination in a most eminent degree, and that it had the remarkable quality of not decomposing or becoming rancid, no matter how long it was kept under the action of the atmosphere. He continued to use this oil obtained from the coal mine as long as it lasted; but after a time it failed, and no more of it could be procured. This induced Mr. Young to turn his attention to the discovery of some means of artificially

producing this particular oil. He descended into the coal mine where the spring had existed, and he considered carefully all the circumstances under which this oil was produced, and he came to the conclusion that it was a product which might be obtained from highly bituminous coal under a process of distillation. He obtained very bituminous coal; and, on trying experiments with it, he found that, by distilling it at a low red heat, this same oil could be obtained—a discovery of very great value, as you will find from the evidence. This oil, he found, consisted of a substance known under the name of "paraffine," in a liquid state, and that it possessed the remarkable peculiarities to which, a while ago, I briefly adverted. It appears to be a compound of hydrogen and carbon in almost equal parts, and the result of this equality in the proportion of the compound elements is, that it has little or no affinity for any other substances in nature. It is not decomposed by the action of the oxygen in the atmosphere—that grand arch-destroyer of illuminators. It has no affinity, in any of its parts, to the oxygen of the atmosphere in preference to its other compound elements, and the result is, that it will keep for any indefinite period without any decomposition or damage in any respect. Another advantage, in its use as a lubricant for machinery, is, that it is said to be the most oleaginous or slippery oil—if I may use the expression—that has ever yet been discovered. Its advantages, therefore, in a commercial point of view, are very great indeed, and will not, I think, be attempted to be controverted. The plaintiff took out his patent in the year 1850, and has manufactured this oil under the title granted to him by that patent. The defendants, who are gas manufacturers, have recently commenced infringing upon this patent by manufacturing the same article. As early as the end of January, 1853, the plaintiffs became aware that the defendants were advertising the sale of paraffine oil. In the *Preston Guardian* of Jan. 1, 1853, the defendants inserted an adverment, which was to the following effect:—"To millowners and others. Paraffine oil for machinery. The Hydro-Carbon Gas Company, Manchester, beg to direct the attention of millowners to their paraffine oil, as being an excellent and economical lubricant for machinery. They can supply it in large quantities at moderate prices. Mixed with sperm, fish, or Gallipoli oil, it prevents their turning rancid," &c. In consequence of this, the plaintiffs caused a purchase to be made of ten gallons of this liquid on Feb. 24, and it was proved to be paraffine oil of exactly the same description and quality as that which Mr. Young was selling under his patent. There is no difficulty whatever of identifying the oil. Paraffine oil is a very peculiar liquid. The difference between paraffine and paraffine oil is, that when, by distillation, you obtain this oily matter, if you afterwards condense it by cold, it assumes a peculiarly fine waxy appearance, and is called "paraffine." When once so fixed by the application of cold, it does not dilute at an ordinary temperature; but on the application of heat, it again becomes dissolved. Here is a specimen of the waxy form of it when called "paraffine." [The Attorney-General exhibited a piece of solid paraffine to the jury.]

Lord CAMPBELL: *Unde derivatur* "paraffine"?

The ATTORNEY-GENERAL: From *parum* and *affinis*, from having little affinity to any other substance. The defendants, on a representation being made to them of this infringement of the plaintiff's patent, acknowledged that what they had been selling was paraffine oil, but stated that they had obtained it by a different process from that used by the plaintiff. I will now explain to you the nature of the patents under which the defendants carry on their business. It is alleged that under those patents they are enabled to obtain this paraffine oil, and that, therefore, they have not been guilty of any infringement of the plaintiff's patent. The defendants have two patents. The first is for making illuminating gas, and the process they use is a twofold one. I may observe, in the first instance, that perhaps you, gentlemen, are already aware that if you decompose water you obtain, of course, hydrogen, but that this has not any illuminating property, and only acquires it when mixed with carbon, which may be obtained from tar, or fat, or oil, or similar substances. Now, the defendant, by his first patent, in order to obtain illuminating gas, uses two retorts. In the first he uses coal, upon which water is dropped, and this water becomes partially decomposed. Steam, hydrogen gas, and carbonic oxide arise, and these are kept, and applied presently to the products of the second retort. In the second retort the defendant has an apparatus of iron, upon which he drops oil or tar, which, being decomposed by the action of heat, there arises from it a highly carburetted hydrogen gas. This emits so much smoke, when subjected to the action of fire, that it is necessary to dilute it, which he does by a mixture of the hydrogen gas and carbonic oxide; and the mixture of the two produces a gas which is not only inflammable, but possesses high powers of illumination. Now, the defendant subsequently took out a second patent, in which he retains the first process, with this exception, that he mentions resin as one of the ingredients to be used in the second retort, and he says besides:—

"I have hitherto spoken only of oil, tar, fat, and other similar substances, in reference to the production of the bi-carbonate of hydrogen; but, in the apparatus above described, gas may be obtained from pit coals, which, in such case, only those should be selected which are rich in carbon or olifiant gas. These shall be heated just in the same way as hereinbefore described for generating gas from oil, &c.; only, instead of raising them to a *good red heat*, they should be raised to a *white heat*."

Now, with regard to the first patent, it is quite clear that under no form of that process could paraffine oil be obtained. Paraffine oil can only be got from bituminous coal, or from wood. There are some woods—waxy petroleum, I believe—from which it may be obtained. With regard to the second patent, in which he proposes to use coal, he says that it is to be used for the purpose of generating this illuminating gas at a white heat. Now, I shall show you that the product which is the subject of the plaintiff's patent—namely, paraffine oil—is evolved from the coal at a low red heat; and, if you raise the heat above that, you obtain from the same bituminous coal, not paraffine oil, but a totally different liquid, possessing totally different chemical qualities, namely, naphthaline, and no trace whatever would be visible of paraffine. It is a most curious and striking phenomenon, that from the same material—this bituminous coal—two different degrees of heat being applied, you should obtain from the low heat one product, and from the high heat another product, and that between these two products there should be no affinity and no similarity. I believe that since this second patent was taken out—its object being, mind, to improve the mode of obtaining illuminating gas—the defendants have been using their retorts at a low red heat, and by that means they have obtained paraffine oil, instead of illuminating gas. Now, possibly, it may be attempted to be shown on their part that they have used a white heat, according to their patent. If they attempt to do so, I shall be able to show that they have had recourse to the action of water, internally applied, for the purpose of reducing the temperature within, though, in order to keep up appearances, they maintained the white heat without. Gentlemen, I shall produce various scientific persons before you, and I shall prove by them that, before the plaintiff's patent, the means of obtaining this very important article of paraffine from coal was entirely unknown. The plaintiff had the merit of that discovery; and I believe there will be no difficulty in showing that the defendants have obtained this oil by the same means as those employed by the plaintiff. I shall show you, from the opinion of a body of scientific persons, that they firmly believe, as a matter of science, that it could not be obtained in any other way than by the mode used by the plaintiff; and, if the defendants say that they obtain it by a different process, it will be for them to show what that process is. This, gentlemen, is my case. The novelty of the plaintiff's invention I do not believe they can impugn. Some attempt is to be made, I understand, to rake up some old German chemical books, in which the existence of paraffine oil is mentioned. If that should be done, we shall know very well how to meet it. The production of paraffine oil from coal was not known before the plaintiff's invention. He was the first and true inventor of that important article. That it is an article of great practical utility cannot be controverted by the defendants, because they profess to sell it themselves; and I shall have no difficulty in showing you that the defendants produce it by a process, if not identical with, at all events equivalent to, that employed by the plaintiff. This is a matter, gentlemen, of great importance to my client, for the damage to him would be most considerable, if others are allowed to benefit by his discovery, and to rob him of the fruits of his invention.

Mr. BRAMWELL, Q.C., read the plaintiff's and the defendant's specifications.

Mr. HILL drew the attention of his lordship to the circumstance that the plaintiffs made no charge against the defendants for paraffine, but merely for paraffine oil.

Mr. *James Young*, the plaintiff, was then called and examined by Mr. BRAMWELL, Q.C.

I have been for many years a manufacturing chemist, and am now carrying on business at Bathgate and at Glasgow, as the manufacturer of this paraffine oil. I was for many years employed at the chemical works of Messrs. Muspratt. My attention has been particularly directed to the chemical products of coals. Dr. Lyon Playfair directed my attention to a spring of petroleum, or rock oil, which had been discovered issuing from a coalpit at Riddings, near Alfreton, in Derbyshire. I experimented upon the spring. I was aware at the time that there was a substance called paraffine.

Lord CAMPBELL: How long has that substance called "paraffine" been known?

Witness: Since the year 1830, my lord. I had seen a piece of paraffine, but I had never seen any paraffine oil. The piece which I saw was not an ounce in weight. It was made at Glasgow about the year 1836, from some wood tar, by Mr. Thom. It was not, however, obtainable in quantities sufficient for a commercial purpose. On experimenting upon this rock oil, given to me by Dr. Lyon Playfair, I found that it contained paraffine oil, from which I produced paraffine. I accordingly took a lease of this mineral spring, and I continued to manufacture paraffine oil from it, and sold it, until at length I exhausted the spring. Until I manufactured paraffine oil from that spring, it had never existed as an article of commerce.

Lord CAMPBELL: Then you first introduced it as an article of commerce?

Witness: I did, my lord. On discovering the spring of rock oil, I endeavoured to find means of procuring the same liquid artificially; and, proceeding upon the idea which I had formed from my investigations—that the mineral spring was produced, by some operation of nature, from the coal in the pit from which it issued—I at length discovered my present invention for obtaining paraffine oil from bituminous coal. I obtained the crude paraffine oil by distilling bituminous coal at a low red heat, and the more bituminous the coal the better. All bituminous coal will yield more or less paraffine, but anthracite will not produce any in an appreciable quantity. I am acquainted with the manufacture of illuminating gas. The great object of the gas manufacturer is to get as large a quantity of gas that will not condense as possible (within certain limits); and, to effect this, a white heat is generally applied in the ordinary processes of gas manufacture. The coals are put into a retort, and are distilled, and the gas passes through a pipe, part of it condensing into tar, and the rest of it remaining in an uncondensed condition. The common coal tar is considerably heavier than water, and paraffine oil cannot be extracted from it in any useful quantity. As much as 30,000 cubic feet of uncondensable gas may be produced from a ton of some descriptions of fuel.

Mr. HILL said that the expression used in the specifications was "permanent gas," and they had, therefore, perhaps, better adhere to it.

Witness: In my process, my object is to get as little permanent gas as possible, and at the heat I use I do not get more than 2000 or 3000 cubic feet a ton. Instead of gas we get paraffine oil. The specific gravity of paraffine oil is much lighter than water. [Specimens were

shown to the witness of coal tar and crude paraffine oil.] There is a difference between the paraffine oil and the coal tar in specific gravity, in colour, and in smell. The paraffine oil contains in it the carbonated hydrogen which would have gone off in the gas. Naphthaline can be obtained from tar which is the product of a high heat. The solid paraffine can be obtained from the paraffine oil by crystallisation. At present, the solid paraffine is not employed much for any commercial purpose. It is used for making candles, and for lubricating purposes. I have manufactured and sold at the rate of 8000 gallons a week of this paraffine oil. I have had considerable experience in chemical matters, but I was not aware, at the time of my invention, that paraffine oil had ever been obtained from coal. I do not believe that paraffine could be made from coal, except through the medium of the oil. [To a JUROR.] It has been made from peat. I consulted Dr. Frankland, among other gentlemen, with reference to my invention. I have examined samples, which I received from Mr. Binney, of paraffine oil, obtained at the defendants' Hydro-Carbon Gas Works, Manchester.

Mr. HILL: I am prepared to admit one of the breaches: that we sold the plaintiffs some paraffine oil on the day stated in the declaration, there can be no doubt whatever as to that fact.

Lord CAMPBELL: Of course; the real question is only, how you made it?

Witness's examination by Mr. BRAMWELL continued: I could not swear whether the specimen produced as obtained from the defendants' works was made from coal or from wood; but from the smell, and other indications, I should believe it to have been made from coal. I know of no other process by which it can be made from coal than by subjecting the coal to destructive distillation at a low red heat, and afterwards refining the product. The lower heat at which we can practically work, the greater the proportion of paraffine which the fluid will contain; the higher the heat, the less paraffine and the more naphthaline you obtain. Naphthaline is, I believe, perfectly useless.

Mr. BRAMWELL: It is called "the gas maker's pest," for the more they get of it, the less they like it. (Laughter.)

Cross-examined by Mr. HILL, Q.C.: The process of manufacturing gas from coals is commonly called destructive distillation. The three principal products that result from the coal in this process are the coke, the permanent gas, and the gas tar. Though a very great heat is necessary for the production of gas, yet it is possible to destroy the illuminating property of the gas by too high a heat, and then you get "marsh gas." The quantity of tar that is obtained depends, of course, upon the bituminous character of the coal which is employed. If the heat be low the proportion of tar to that of gas is greater. Gas tar was well known as an article of commerce before the date of my patent, and I was familiar with its distillation. In distilling gas tar, oils of different density are produced. There is a light oil from which naphtha is produced, and it is known as "light oil" or "crude naphtha." There is another oil known by the name of "heavy oil," or "dead oil." It was not used, that I am aware, for the purpose of lubricating. The only use that I know of its being put to was pickling wood—that is, preserving wood for sleepers. I am quite sure that, in my experience, I never knew of any other use to which "heavy oil" was put. The principal case of tar distillation I was acquainted with was in the works of Messrs. Jennet, of Leith. I am able to say that I never got a trace of paraffine from heavy oil. I examined it for the purpose in Manchester, in the beginning of 1852. I did not obtain it in the form of tar; I only worked upon the dead oil, which, if I recollect right, was sent to me from works at Birmingham, but I am not quite sure. Paraffine cannot be obtained in the ordinary process of gas making in any appreciable quantity. I don't say that it is impossible to get a trace of paraffine; but you cannot obtain it in any marketable quantity. I have never experimented upon gas tar, where bituminous coals have been used, with a view of obtaining paraffine, but my assistant has.

The ATTORNEY-GENERAL: Were you present at the experiment?

Witness: Part of the time.

Mr. HILL: Did you see whence the tar had been obtained?

Witness: No, I did not. I was first acquainted with paraffine in the year 1830. As a chemist, I have received my instructions from books, as well as from my own experiments. I have read the ordinary popular works upon chemistry.

Mr. HILL: And did you not, before your patent, obtain information that paraffine could be produced from bituminous coals by distillation at a low heat?

Witness: I had no such information before the date of my patent.

Mr. HILL: Under any circumstances?

Witness: No.

Mr. HILL: A paraffine oil—oil containing paraffine?

Witness: No.

Mr. HILL: Do you now know that it was well known before your patent?

The ATTORNEY-GENERAL: I object to that question.

Lord CAMPBELL: The witness has to speak to facts. You are now merely asking him what he has read, or what somebody has told him.

Mr. HILL: But I submit, with deference to your lordship, that the witness, being a party to the action, may be asked whether he now knows that such a mode of obtaining this substance was known before the date of his patent.

Lord CAMPBELL: How can he know it as a fact? You can ask him whether somebody has told him.

Mr. HILL: You say you have obtained your knowledge of chemistry from books as well as from experiments?

Witness: From books and lectures in the laboratory.

Mr. HILL: Well, from the knowledge you have obtained in that manner, how long has the information been published that paraffine has been obtained from coal.

The ATTORNEY-GENERAL: I object to that, because it is really seeking to avoid putting in these books, which would enable the jury to form a correct opinion of this ground of defence. If you have any such books, put them in, and let the jury see them.

Lord CAMPBELL: You cannot establish the fact by such a question.

Mr. HILL: But the witness comes here as a scientific witness, and I venture to submit that he may be asked this, as a matter of scientific knowledge.

Lord CAMPBELL: But you ask him, as a fact, whether it was not so and so.

The ATTORNEY-GENERAL: As a matter of scientific knowledge, he may know that a certain result may be obtained, but he cannot speak to what other people know.

Cross-examination resumed: The Boghead cannel coal, which is obtained from Bathgate, in Scotland, will yield 30,000 cubic feet of gas per ton. The Boghead cannel has been in the market since 1850, and it has come into very extensive use since then. It is the coal which I principally use. It is a very rich bituminous coal. I never got a pure specimen of the tar obtained from it in the ordinary process of gas making. All that I ever got was mixed with other coal. The proportion of tar which you would get from the Boghead cannel would depend upon the heat. I am not quite sure whether, at the ordinary heat of the process of gas making, it would yield more tar than any other coal. I don't think I can give a definition of petroleum. It is a fluid that comes out of the earth.

Mr. HILL: What is it generated by?

Witness: That is a scientific question.

Mr. HILL: Well, if you are not able, as a scientific man, to answer it, say so.

Witness: I am not able.

Lord CAMPBELL: I thought you said that you conceived it had been produced by an effort of nature in the coal-mines?

Witness: In some coal mines it is so, but it often occurs where there is no coal mine.

By Mr. HILL: I consulted Dr. Frankland personally. He did not advise me not to claim the paraffine oil.

Mr. HILL: Will you pledge your oath that he did not advise you to limit yourself to the paraffine?

Witness: I don't recollect the whole conversation, so I cannot.

Mr. HILL: Well, will you say that he did not?

Witness: He did not find fault with the specification.

Mr. HILL: I know that. He said your specification was perfectly intelligible; but did not he recommend you to confine yourself to the paraffine, and not to claim the paraffine oil?

Witness: I don't recollect his saying so.

Mr. HILL: Will you say that he did not?

Lord CAMPBELL: He may have given you that advice?

Witness: It is quite out of my recollection, but I know that Dr. Frankland said that the invention was new, and, therefore, I cannot conceive why he should advise me not to claim it.

Mr. HILL: Did he not advise you not to claim the paraffine oil?

Witness: Not as far as I can remember. I have not the slightest recollection of it.

Re-examined by Mr. BRAMWELL, Q.C.: Dr. Frankland and another gentleman settled my specification. Mr. Binney and Mr. Leigh were present. There is no appreciable quantity of paraffine in the tar produced by the ordinary process of gas making. I have read the specifications of the defendant's patents. If he works at a white heat, according to his specification, he would not get an appreciable quantity of paraffine from his tar. Resin, fat, tallow, oil, and coal, are enumerated in his specification as substances he deals with in his process. Leaving out coal, paraffine could not, as far as I know, be obtained from the tar produced by the distillation of those other substances.

By Mr. HILL: I never made any experiment, but I understand that, in order to carry out the defendant's process for the purpose of making gas, it is necessary to have a bright red heat, in order to convert the water which is introduced into the retort into hydrogen gas. The mixed gas so produced is said to contain carbonic oxide, carbonic acid, and hydrogen; but I don't know of my own knowledge. There is a communication between the first and second retort, and they are heated by the same furnace; but the heat of the second retort depends upon the quantity of water that is introduced. The nature of the gas found in the second retort when bituminous coal is used, is a matter of dispute upon which the promoters of the scheme are not agreed. Some say that olifiant gas is produced, but, of my own knowledge, I don't know. I have made no experiments as to the products when Boghead cannel coal is used in such a process. The heat of the retort would be undoubtedly reduced to the extent of the steam that would be allowed to enter.

Mr. *Hereford*, coroner of the city of Manchester, produced the depositions taken by him of the evidence of William Collier, Stephen White, and Edward Farrow, at an inquest held at the Manchester Infirmary, Feb. 15, 1851, on the death of Jonathan Low. The deposition of Mr. White, the defendant, was signed "Stephen White, 51, King-street, Manchester, gas engineer."

Dr. *Lyon Playfair*, examined by Mr. WILLES.

I am a chemist, and was one of the special commissioners at the Great Exhibition, 1851. The plaintiff's invention was exhibited there. I am well acquainted with the products of the distillation of coal; and I delivered a lecture at the Royal Institution upon the three principal chemical discoveries which distinguished the Great Exhibition. One of the discoveries I selected was this paraffine, which the plaintiff had discovered could be produced by the distillation of bituminous coal at a comparatively low temperature.

Mr. WILLES: So far as your knowledge extends, was the production of paraffine oil a novel invention?

Witness: From coal it was. I was not aware that it had been done before.

Mr. WILLES: Supposing it had been proved as a fact, would it have been likely to have come to your knowledge as a chemist?

Witness: I think so. If it had been familiarly known at all, it must have come to my knowledge.

Cross-examined by Mr. GROVE, Q.C.: As far as your knowledge at present extends, are you aware that it has been obtained from coal?

The ATTORNEY-GENERAL objected to the question.

Lord CAMPBELL decided that it was irregular.

Mr. GROVE: As far as your knowledge now extends, was the obtaining of paraffine oil from coal, at the date of the patent, wholly new?

The ATTORNEY-GENERAL also objected to this form in which the same question was put. There was a distinction between the knowledge which the witness had at the time the patent was granted, and his knowledge at the present moment, derived, perhaps, from information received from some book or other, or from some person. He might be asked whether, as far as his knowledge went at the time, the invention was a new one or not.

Lord CAMPBELL: You see that the anterior use of the plaintiff's process cannot be established by any answer that the witness can give to such a question. I should say that it was a mere catching question if it were put upon such a ground. I assume that part of the defence of this case is, that Young's mode of obtaining this paraffine oil was known before he procured his patent. Then I think that you cannot establish that by asking this witness whether, according to his knowledge now, the process was, or was not, new at the time of the patent. [His lordship, at the request of Mr. Grove, took a note of the question.]

Cross-examination by Mr. GROVE continued: I do not know a book called the "Encyclopædia of Chemistry," published at Philadelphia. Brande's "Dictionary of Science, Literature, and Arts," is a work generally read by chemists. It is probable that I was acquainted with that work before October, 1850. Brande's "Manual of Chemistry" has undergone many editions; and it was very familiarly known to chemists before the patent. Turner's "Elements of Chemistry," Mitsherlich's "Chemistry," Dumas's "Traité de Chimie appliqué aux Arts," "Annales de Chimie et Physique," Sir Robert Kane's "Elements of Chemistry," Graham's "Elements of Chemistry," and Berzelius's "Chemistry," are all popular works, which were familiarly known to chemists before the date of the plaintiff's patent. I believe Reichenbach was the original discoverer of paraffine. I do not know where his researches on the subject were published, as I came here quite unprepared, having been unexpectedly summoned from Scotland. Reichenbach's experiments were published, I think, about the year 1830. I was aware that paraffine had been produced in the distillation of wood and of bituminous schist, and from a petroleum called Rangoon naphtha. I have heard of the controversy as to whether the Boghead cannel coal was a coal or a bituminous schist. I presume that there would not be any substantial difference between the process that would be used for obtaining paraffine from bituminous schist or from coal. Both would be by distillation, and the process of purification would probably be the same. The employment of sulphuric acid in the purification of oils is not new; it is very commonly employed. I presume that the neutralisation of the sulphuric acid by caustic potash is also very commonly employed. I read Mr. Young's specification when it was first enrolled, but not since.

Mr. GROVE: Do you know of anything in that specification which is in any respect new?

Witness: The distillation of coal at a low heat, in order to produce paraffine, is a novelty. I do not recollect that there was anything which struck me as being new in the apparatus, or in the process, so far as the distillation in retorts and the purification.

Mr. GROVE: Do you know that Du Buyson manufactured paraffine from bituminous schist some time ago?

Witness: I am not quite sure of the name, but I know that it was manufactured.

Re-examined by the ATTORNEY-GENERAL: These books to which my learned friend referred, and which you say were well known to chemists, were very well known to yourself; and you were, at the date of the patent, quite familiar with them?

Witness: I was.

The ATTORNEY-GENERAL: And yet I understand you to say that in the year 1850, the date of the plaintiff's patent, you were not aware that paraffine had ever been extracted from bituminous coal?

Witness: I was not in the least.

Professor *Graham*, examined by the ATTORNEY-GENERAL.

I am professor of chemistry at the University College, and was deputy-chairman of the Chemical Jury of the Great Exhibition, 1851. Some paraffine oil obtained from coal was exhibited by the plaintiff; and, as I had to make a report, my attention was directed to the subject. Before that time I had not heard of the distillation of paraffine or paraffine oil from bituminous coal. As far as my knowledge went, it was an entirely new production. I am familiar with the works that were mentioned in the evidence of Dr. Lyon Playfair. I consider the plaintiff's invention an exceedingly valuable discovery. The paraffine is obtained from coal by distillation, at a low red heat. If the heat be increased to a good red heat, or white heat, the paraffine would be destroyed, and become converted into gas; and at a high stage naphthaline would be obtained. A low red heat was the highest heat at which paraffine could be obtained in any large quantities.

Cross-examined by Mr. HILL, Q.C.: I knew of the existence of paraffine before the plaintiff's patent. It had been obtained by the distillation of wood—principally beech wood—and from petroleum, and bituminous schist and turf. I never knew it to be got from coal tar. It has been extracted from the tar of wood. The products of the destructive distillation of coal were well known at the date of the patent.

Mr. HILL: But I think you say that you were not aware at the date of the patent that paraffine had ever been obtained from coal?

Witness: I can scarcely state what my knowledge was. My belief was that it existed. I think I rather inferred from analogy that there must be some paraffine in coal tar, as in wood tar, but I did not know it as a fact. I know the Boghead cannel, and, in my opinion, it is decidedly a coal, and not a schist. I have never seen any tar produced from it.

Mr. HILL: Supposing it was subject to the ordinary process of gas making, and coke produced from it, in your judgment would paraffine oil be obtained from that tar?

Witness: I should infer that in all coal there would be a trace of paraffine, but not any available quantity.

Mr. HILL: But I specify this particular Boghead coal. Don't you think it would be found more in the tar from this coal than in that from any other coal?

Witness: I am not sure.

Re-examined by the ATTORNEY-GENERAL: I never knew paraffine, before the plaintiff's invention, to have been extracted from any substances in such quantities as to be of any commercial value. It was simply extracted as a matter of scientific curiosity, and the plaintiff's invention was the first instance of its being brought to a point of commercial utility.

By Mr. HILL: The books which have been mentioned are well known, and are standard works among chemists.

The ATTORNEY-GENERAL: And you, as a practical experienced man, familiar with those books, were not, at the date of the patent, aware that paraffine could be obtained from coal?

Witness: No; I was not.

Dr. *Augustus William Hoffman*, examined by Mr. BRAMWELL, Q.C.

I am director of the laboratory of the Royal College of Chemistry, and professor of chemistry in the Metropolitan School of Science applied to the Arts. My attention has been particularly directed to hydro-carbons. I was joint reporter of the Jury, Class XXIX., Miscellaneous Manufactures, in the Great Exhibition of 1851. I examined Young's specimens of paraffine oil and paraffine. I was not aware that paraffine oil had ever been before obtained from bituminous coal. I read the plaintiff's specifications. If there had been any mode of obtaining paraffine oil or paraffine from coal before the time of the plaintiff's specification, I think it would have come to my knowledge. I was aware of the existence of paraffine. I had only seen, however a small laboratory specimen before I saw the quantity exhibited by Young. At a high temperature the distillation of coals yields gas, and a substance which has sometimes been confounded with paraffine, viz., naphthaline. They are two different chemical individuals. Naphthaline is not employed for any purpose, as far as I am aware. I am aware that Liebig, in one of his letters, a great many years ago, spoke of the great desideratum to chemistry—the discovery of a mode of condensing coal gas into a white and solid substance, so as to render it capable of being burned in a lamp.

Cross-examined by Mr. WEBSTER: Naphthaline and paraffine are quite distinct. I am acquainted with the works which have been referred to.

Mr. WEBSTER: Then I will read you a passage from Dr. Kane's book.

Lord CAMPBELL: You cannot do so.

Mr. WEBSTER submitted that it was the invariable practice to read passages to scientific witnesses.

Lord CAMPBELL: What I have to determine is, whether you have a right to read a passage from Dr. Kane's work. You have not.

Mr. WEBSTER: I propose, my lord, to read a passage from Dr. Kane, and then to ask the witness whether that describes the plaintiff's invention. Your lordship rules that I have no right to do so?

Lord CAMPBELL: I rule that you have no such right.

Mr. *John Stenhouse*, examined by Mr. WILLES.

I am lecturer on chemistry at St. Bartholomew's Hospital, and have made chemistry my study for many years, particularly with regard to hydro-carbons, such as coal and its products. I read the plaintiff's specification when enrolled, and made myself acquainted with the nature of his invention. According to my knowledge, the invention was a new one. I never knew before of any mode of obtaining paraffine from bituminous coal. It was always considered a great desideratum, as paraffine is applicable to a very great number of useful purposes. I have read the defendant's specifications very carefully, and have paid attention to the process which he describes for making gas.

Mr. WILLES: Now, suppose that process be followed, as is described, would any paraffine be produced?

Witness: Certainly, it would be produced.

Mr. WILLES: From what would it be produced?

Witness: It would be produced from the lowness of the temperature at which the second retort, in which the distillation is carried on, would be, in consequence of the steam and the gases entering into it.

Mr. WILLES: But supposing, Dr. Stenhouse, the heat to be raised to the point of red heat, would there be any paraffine produced then?

Witness: No, there would not, or very little. If the heat were raised to the ordinary temperature at which gas is manufactured, there would not be any appreciable quantity of paraffine.

Lord CAMPBELL: The defendants say—"The coal is to be heated in the same way as before described for generating gas from resin, &c., only, instead of raising the retorts to a good red heat, they should be raised to a white heat." If that be done, in pursuance of these directions, would any paraffine be produced?

Witness: Scarcely any, if you did not cool down the retorts by introducing something to cool them.

Lord CAMPBELL: If the process in the defendant's specification be strictly followed, would there be any paraffine produced?

Witness: I expect there would, because the temperature of the second retort would be low.

Lord CAMPBELL: But if that retort be kept at a white heat?

Witness: Ah! if you could keep it at a white heat, then scarcely any paraffine would be produced.

Mr. WILLES: Would there be any gas if paraffine were produced?

Witness: There would be a proportionate diminution of the gas. The paraffine produced would be so much abstracted from the gas.

Mr. WILLES: Would the formation of paraffine be in pursuance of the object of making gas?

Witness: It would not, because it would reduce the quantity of gas.

Lord CAMPBELL: What is the object of the defendant's specification?

Witness: To make a larger quantity of gas.

Lord CAMPBELL: Well, then, if the gas were made at a proper temperature, would paraffine be one of the products?

Witness: In no appreciable quantity. If the retorts were at a low heat it would be produced.

Lord CAMPBELL: Would that be a proper proceeding for generating gas?

Witness: Certainly not.

Lord CAMPBELL: If the temperature were low enough to produce paraffine, that would not be a proper temperature for the production of gas?

Witness: No; there is no gas manufacturer, at least in London, that does not use a bright red or a white heat. I have analysed the oil sold by the defendants, and found it to contain paraffine.

Lord CAMPBELL: It is not disputed, I suppose, that the defendants make paraffine oil?

Mr. HILL: It is not disputed that the oil they sell contains paraffine.

Witness: It contains a great deal of paraffine. I could not judge from its appearance from what it had been obtained. It might have been a natural petroleum.

Lord CAMPBELL: I suppose the defendants admit that it came from coal?

Mr. HILL: I have admitted that it was sold, and that it is paraffine oil, but I am certainly not going to make any further admission in their case.

Lord CAMPBELL: You are quite right; you cannot be expected to do so.

Mr. WILLES: Do you know of any other way of making paraffine oil from coal except by Young's process?

Witness: And by the defendant's. (Laughter.)

Mr. WILLES: Well, can you get it by distilling bituminous coal in any other way except at a low temperature?

Witness: I believe not.

Cross-examined by Mr. HILL, Q.C.: I have never seen any gas tar procured from the Boghead cannel coal by the ordinary process of gas making.

Mr. HILL: Did I understand you right that, if the process pointed out in the defendant's specification be strictly followed, paraffine must be produced?

Witness: I believe so, if strictly followed, so that the temperature will be low.

Mr. HILL: I mean if it be strictly followed, according to the process, as described in the specification?

Witness: It depends, then, upon the water. But if they truly keep it at a white heat they will not produce any; but if, by any circuitous means, they contrive to cool the interior of the retort, then they will get paraffine. I am aware that their object is not to get ordinary coal gas, but a mixture of coal gas and water gas. I am not acquainted with any other gas works in which the defendant's process is used. The gas manufacturers I spoke of obtain their gas purely from coal.

Mr. HILL: You say that the plaintiff's invention is a new one. Now, point out what, in your judgment, is a novelty in his specification.

Witness: The obtaining of paraffine or paraffine oil, by distilling coal at the lowest temperature at which you can decompose it. That is a novelty.

Lord CAMPBELL: The novelty, then, lies in the temperature?

Witness: Yes, my lord.

Mr. HILL: There is nothing in the retorts that is new?

Witness: No.

Mr. HILL: Or in the purification of the oil?

Witness: I am not aware that dead oil has ever been treated with sulphuric acid, because it would not pay.

Mr. HILL: But in the purification of oils, was not sulphuric acid used before the plaintiff's patent?

Witness: Yes, for valuable oils—for animal or vegetable oils—but not for what are called the "dead oils" from coal tar.

Mr. HILL: The mode of purification, though new with regard to this oil, yet is not new as a mode of purifying oils?

Witness: Certainly not.

Mr. HILL: Would the necessary effect, in your judgment, of the use of the water in the defendant's invention be to cool the temperature?

Witness: Decidedly.

Re-examined by the ATTORNEY-GENERAL: Then I suppose the white heat, if kept up, would maintain the temperature at its proper heat?

Witness: The retorts are composed of iron, and there are besides inside masses of difficult conductors, so that the outside may be red hot, and yet the interior comparatively cold.

The ATTORNEY-GENERAL: Supposing the defendant kept up that amount of white heat necessary to produce a full amount of gas, and introduced no more water nor steam into the retort than is stated in his specifications—namely, so much as is necessary for the production of his gas—would he then get any paraffine?

Witness: It would altogether depend upon the temperature of the interior of his retorts.

Lord CAMPBELL: If he were to do his best to get as much gas as possible, would he get any paraffine?

Witness: If working as a true and legitimate gas manufacturer, with the true intent of producing gas, he would get hardly any paraffine.

Andrew Fyfe, M.D., F.R.S., Professor of Chemistry at Aberdeen, examined by Mr. WILLES.

My attention has been particularly directed, during the last thirty years, to the chemistry of coal, with reference to the manufacture of of gas. I am acquainted with the specifications of the plaintiff and the defendant's patents. I was not acquainted with paraffine as a product from coal before Young's patent. I consider the plaintiff's a very valuable discovery. No appreciable quantity of paraffine could be produced by the defendant's process, in consequence of the high temperature required; and if the temperature be lowered, paraffine would be obtained, but there would be a corresponding diminution of gas, which is the object of their patents.

Cross-examined by Mr. GROVE, Q.C.: No water is used in the ordinary process of gas making. In White's process, the gas is obtained both from water and from coal.

Mr. GROVE: Would the passing of the water through the retort, as described in the specifications, necessarily cool it?

Witness: If used in a proper quantity, it would not cool it much.

Mr. GROVE: Would not the passing of water, carried off in steam, into the retort, have a cooling effect? Is not that one of the commonest modes by which heat is reduced?

Witness: Certainly.

Mr. GROVE: What is there in White's process which would prevent the natural cooling effect?

Witness: Keeping up the temperature.

Mr. GROVE: But that temperature would be absorbed by the passage of the water into steam as fast as it was kept up?

Witness: Certainly, but then the fires must be increased.

Mr. GROVE: You must have an apparatus which must keep the steam greatly confined?

Witness: Yes.

Mr. GROVE: Is it possible to get steam to a red heat without a very strong apparatus? Has it ever been done to your knowledge?

Witness: Well, it has been said so.

Mr. GROVE: As a very remarkable experiment?

Witness: Yes; the quantity of paraffine oil obtained by any process—whether the plaintiff's or defendant's—must vary in different degrees, according to the temperature and the ingredients in the retort. At a high heat there would be very little. An extremely high heat, though I cannot say the exact degree, would destroy paraffine altogether.

Re-examined by Mr. WILLES: When the temperature is high enough to produce gas, what is the liquid product?

Witness: Coal tar.

Mr. WILLES: Is that at all the same thing as paraffine oil?

Witness: No; coal tar sinks in water, paraffine oil floats. If you use a high temperature, you get much gas and coal tar; if you use a low temperature, you get little gas and paraffine oil. I have examined White's paraffine oil. It contains under two per cent. of paraffine.

Mr. WILLES: You have been asked whether the effect of steam introduced into the retort would cool it. If the quantity of water used in the defendant's apparatus were such as was proper for the production of gas, would the effect be to produce paraffine oil?

Witness: Certainly not, if the retorts were kept in a state fit to make gas.

Mr. *Samuel Clift*, manufacturing chemist, examined by Mr. BRAMWELL, Q.C.

I am manager of the chemical works of Mr. Bethell, who has two establishments—one near Birmingham, and the other in Lancashire. I have turned my attention a great deal to the distillation of tar and the other products of coal. I am acquainted with the plaintiff's process, as described in his specification, of obtaining paraffine oil from coal. His specification is intelligible, and any practical chemist could work from it. Until I read his specification I was ignorant of any mode of producing paraffine oil from coal. I have made experiments at Mr. Bethell's works upon the distillation of common coal tar obtained from gas works, with a view of seeing whether I could get paraffine oil from it, but I have never succeeded. The tar was the product of cannel coal, which is a highly bituminous coal. I am acquainted with the defendant's process of gas making. To make illuminating gas economically from coal, it is necessary to employ a good red heat.

Mr. BRAMWELL: So that, in truth, the defendant's gas patents are patents from which you can make gas, and not paraffine if used as described? [The question, being objected to by the other side, was not pressed.]

Cross-examined by Mr. HILL, Q.C.: I have made a great many experiments upon heavy oils.

Mr. HILL: In your opinion, if White's specifications be followed out, will a low red heat or a white red heat be produced?

Witness: If they pass in more water than is necessary, there will be a low red heat.

Lord CAMPBELL: But if they keep it at a proper temperature for making illuminating gas?

Witness: Then they would obtain no paraffine: a very little indeed.

Mr. *Miller*, manufacturing chemist at Glasgow, examined.

Had made a great deal of investigation with respect to coal tar, and the products of the distillation of coal, but he never heard, before the plaintiff's patent, of any mode of obtaining paraffine oil from coal. Witness was a distiller of coal tar, but had never found any appreciable quantity of paraffine in it.

Cross-examined by Mr. HILL, Q.C.: Did you search for it?

Witness: After Young's patent, I was very anxious to find it, but I never could catch it. The heats used in the gas-house are too high.

Mr. *John Thom*, calico-printer, at Chorley, Lancashire, examined.

Was for some time with Messrs. Turnbull, of Glasgow, manufacturing chemists, and while there made several experiments, with a view of obtaining paraffine. He succeeded in producing a small quantity from wood tar, but he did not find any in coal tar. He could not obtain any in sufficient quantities to be of any commercial value. Never knew, before the plaintiff's patent, of paraffine being produced in any commercial quantities from coal.

Cross-examined by Mr. GROVE, Q.C.: Don't you know, as a

matter of chemical knowledge, that paraffine was produced from coal before the plaintiff's patent? [Question objected to, and withdrawn.]

Mr. *John Leigh*, F.C.S., surgeon, and consulting chemist to the Manchester Corporation, examined.

I have read Young's specification. I have directed my attention a great deal to hydro-carbons. To my knowledge, at the time of the patent, the plaintiff's was a novel invention. Naphthaline is an entirely different substance from paraffine. Paraffine is not such an article as would obstruct the passage of the pipe from the retort, so as to cause an explosion. It is not so volatile as naphthaline. My impression is, that the fatal explosion at Salford arose from the presence of naphthaline, and not of paraffine.

Mr. HILL submitted that this was not evidence.

Lord CAMPBELL: It does not seem to me to have any more relation to the questions at issue than the destruction of Pompeii. (Laughter.)

Mr. BRAMWELL said that there was an accident at the defendants' works at Salford. He would put in the depositions taken at the inquest held in consequence of the fatal result of that accident; and then his case, on this point, would be rendered more intelligible.

Witness's examination continued: I was present when Dr. Frankland advised with the plaintiff as to his specification. I do not think that paraffine could be obtained in any appreciable quantity from the common coal tar which is produced from the manufacture of gas.

Cross-examined by Mr. HILL, Q.C.: My opinion of the Boghead cannel coal is, that it is a bituminous schist, and not a coal. I devoted some time and attention to the examination of that mineral. I said that I was not aware that paraffine had been obtained from coal, but I knew that it had been obtained from bituminous schist. Du Buyson, some years before this, made known that it could be obtained from bituminous schist, but I am not aware that it was ever manufactured in this country. I did not know whether the distillation was to be at a low heat or at a high heat.

Re-examined by Mr. BRAMWELL, Q.C.: There is a great diversity of opinion as to what the Boghead cannel really is. There is no received definition yet of what a coal is. The Boghead cannel is a brown substance used solely, I believe, for the manufacture of gas and paraffine oil. Paraffine has been obtained from the schist as an experiment, but not for commercial purposes, to my knowledge.

Mr. *Edward William Binney*, one of the plaintiff's partners, examined.

I am a solicitor at Manchester. The defendants carry on their business as hydro-carbon gas manufacturers, in King-street, Manchester, and Philip-street, Salford. I first heard of their selling paraffine oil about the 20th of January, 1853. I sent a person of the name of Wilde to purchase some of the defendants' oil, and I gave portions of it to the plaintiff, Mr. Meldrum, Mr. Leigh, and Dr. Fyfe. I have paid considerable attention to the defendants' process, and I have been at their works. I was secretary of the Manchester Philosophical Society when the defendant White exhibited a model of his apparatus, and I saw it also exhibited at the Athenæum. Up to June, 1851, the defendants used resin in all their experiments. In 1852 I went to Southport and to Rhodes, and I there saw the retorts in active operation. They were then using Boghead cannel coal, such as Mr. Young uses, instead of resin. I saw some of the retorts drawn. The heat of those at Rhodes was a common red heat in daylight. It was not so high a temperature as I have seen at all the other gas works I have visited. At Southport it was a bright red heat. The ash at Rhodes was, as at our works, soft, and there was very little coke. I could not tell the defendants' object in working the retorts in the manner I have described.

Lord CAMPBELL: Are you acquainted with the proper mode of conducting retorts for making illuminating gas?

Witness: I am not practically acquainted with it. I visited the defendants' works at Salford in February, 1853. I am acquainted with the mode of purification adopted at our works in Scotland. I saw a similar process at work at the defendants' works. I have made coal my study during the last twenty years, and I am certainly of opinion that the Boghead cannel is a coal.

Lord CAMPBELL: You ought not to be so dogmatical; for the last witness, who is a scientific man, thinks otherwise. (Laughter.)

Witness: My opinion is confirmed, my lord, by the verdict of the jury at Edinburgh.

Cross-examined by Mr. HILL, Q.C.: The defendants' works at Southport, near Liverpool, are for lighting that town, which contains about 20,000 inhabitants. The works at Rhodes were built in order to fulfil a contract for lighting the print-works of Messrs. Salis, Schwabe, and Co.

Mr. *Edward Meldrum*, manufacturing chemist, Bathgate, examined.

I am one of the plaintiff's partners. My attention has been for a long time directed to the distillation of coal, and I have had considerable experience in coal tar. Coal tar is not at all similar to paraffine oil, nor is it at all applicable to any of the uses of paraffine oil. Since Mr. Young's patent, I have superintended the works at Bathgate. A low temperature is necessary to produce paraffine. Before the plaintiff's patent, no such thing was known as the production of paraffine oil from coal. Dead oil was known. Dead oil sinks in water; our oil swims. Dead oil contains more carbon, and is altogether different in constitution from paraffine, and is applicable to none of the purposes for which paraffine oil is useful. The object of the defendants' patents is to produce gas, and, if that object be carried out, only a trace of paraffine would be produced. The percentage of paraffine in Mr. Young's oil was from 12lb. to 13 lb. in 40 gallons, or from 3 to 4 per cent.

Mr. HILL (in cross-examination): If the defendants' oil contains only half the quantity of paraffine that the plaintiff's will yield, can it be said to be the same oil?

Witness: White's oil froze solid on applying cold, and that told me that it was nearly the same.

Mr. HILL: But if there is only 2 per cent. of paraffine in the one, and there is 4 per cent. in the other, are they then the same oils?

Witness: If it contained 2 per cent. of paraffine, it would be paraffine oil.

Mr. HILL: Because it contains paraffine?

Witness: And because the oil is the same as our oil, supposing even that it did not contain paraffine. I have never made any experiments on tar procured from Boghead cannel coal used in the ordinary process of gas-making.

The court adjourned at eight o'clock.

THURSDAY, JUNE 29.

The Lord Chief Justice took his seat on the bench at ten o'clock, when the plaintiff's case was resumed.

Robert Angus Smith, Ph. D., F.C.S., examined by Mr. BRAMWELL, Q.C.

I have devoted a great portion of my life to the study of chemistry, especially organic chemistry. I have studied under Liebig. I have examined both the plaintiff's and the defendant's specifications. The mode of obtaining paraffine oil from coal, invented by the plaintiff, was, to my knowledge, new at the date of the patent. I never heard of paraffine oil in any form before the plaintiff's patent. I had heard of paraffine. The plaintiff could not make gas by the temperature he describes in his specifications. The defendant's process (though when I saw it, it did not seem to me to be conducted according to his specifications) is for the making of gas. I have seen the defendant's gas making apparatus at Rhodes.

Lord CAMPBELL: Were they following the specifications?

Witness: I considered that the white heat enjoined in the specifications was not brought out.

Lord CAMPBELL: Then the retorts were not at the temperature mentioned in the specifications?

Witness: No, my lord.

By Mr. BRAMWELL: They were using a red heat at the second retort at Rhodes. The effect of that would be to bring over the crude paraffine oil. I have seen specimens of the oil purchased of the defendants, and, in my judgment, it is a similar article to that produced by the plaintiffs. I know of no other mode of producing paraffine oil from coal than by distilling the coal at a low temperature.

Cross-examined by Mr. HILL, Q.C.: The novelty of the plaintiff's invention was, first, the production of paraffine in any considerable quantity from coal; and next, the production of paraffine oil.

Mr. HILL: What do you mean by paraffine oil?

Witness: I mean the oil in which paraffine is diluted.

Mr. HILL: An oil containing paraffine?

Witness: It may or may not contain paraffine.

Mr. HILL: What do you mean by "paraffine oil," then?

Witness: I have not investigated it so thoroughly as to give its character; but it was an oil new to me.

Lord CAMPBELL: You are a philosopher, and have devoted yourself to chemistry. Give us a definition of paraffine oil.

Witness: It requires a very thorough investigation to do that.

Lord CAMPBELL: Well, now, supposing you are delivering a lecture, and we know nothing about it, how would you explain to us what paraffine oil was?

Witness: Paraffine oil, as I have received it, differs from any other oils in being much lighter than the thick oils produced by the ordinary mode of distillation.

Lord CAMPBELL: Its specific gravity is much lighter than that of the thick oils?

Witness: And it does not oxidise in the air.

Mr. HILL: Is it no distinctive feature of paraffine oil that it contains paraffine?

Witness: I don't know.

Mr. HILL: Can paraffine oil be obtained from any coal that does not contain paraffine, and is not that the distinction—that it is a crude oil, which contains paraffine, which can afterwards be separated by rectifying the oil?

Witness: That is not my opinion. It is different from any oil I ever saw before.

Lord CAMPBELL: Then your definition of paraffine oil is, that it is different from any other oil. (Laughter.)

By Mr. HILL: Coal distillation in a retort was not novel. The process used by the plaintiff was not new, but the discovery of this product was new. I believe the generalisation is new—that is, the distillation of coals at a low temperature.

Mr. HILL: Dr. Smith, you say you have given considerable attention to organic chemistry. Now, at the date of the patent, was not it well known that paraffine was a product from the distillation of coals?

Witness: It was not well known.

Mr. HILL: Was it known at all?

Witness: It was known that a little had been produced by Baron Reichenbach, who was the only one that had done so; but I never heard that any appreciable amount could be obtained.

Mr. HILL: Did you not know from his books that it might be obtained by distillation at a low temperature from coal?

Witness: Reichenbach said a small quantity could be obtained.

Mr. HILL: But didn't he say—ay or no—that paraffine could be obtained from coal by the distillation of coal at a low temperature?

Witness: Yes, but not in any considerable quantities.

Mr. HILL: Now, I ask you, as a doctor in philosophy, was not it part of the public stock of chemical knowledge in England at the date of the plaintiff's patent, that paraffine could be obtained from coal by distillation at a low temperature?

Witness: That I would decidedly say "no" to. I reside in Manchester, and there are good philosophical libraries there. I am secretary of the Manchester Philosophical Library, and I know that Reichenbach's book is not there, and I have no reason to believe that it was ever in the library. I only visited the defendants' works at Rhodes once, and then I stayed about half an hour. It was rather more than a year ago.

Re-examined by Mr. BRAMWELL, Q.C.: At the date of the plaintiff's patent, I had never heard of paraffine. I had only heard of the

solid substance. I never heard of paraffine having been obtained otherwise than as an experiment; and I don't believe Reichenbach himself ever had. From the information which I possessed at the date of the plaintiff's patent, I could have only made paraffine in exceedingly small quantities from coal.

Dr. *Thomas Richardson*, examined by Mr. HINDMARSH.

I am a lecturer upon chemistry in the Newcastle-upon-Tyne Medical School, and have edited a work upon technical chemistry. For the purpose of editing that book it became necessary for me to pay particular attention to all new inventions, as far as I could obtain information respecting them. I made myself thoroughly acquainted with the nature of Young's invention. In my opinion the production of paraffine oil from bituminous coal was new at the date of the patent. I never knew of paraffine oil having been produced in that way before. I have read the specifications of the defendant's two patents. The object is to produce gas. If the specifications are followed with that object, no appreciable quantity of paraffine will be produced. No appreciable quantity of paraffine can be produced from resin tar.

Cross-examined by Mr. GROVE, Q.C.: Paraffine oil was new, generally, as a fact. Paraffine oil is a hydro-carbon, analogous to paraffine, and containing paraffine, which may be separated from it.

Mr. GROVE: Had paraffine been produced, to your knowledge, from coal before the date of the patent?

Witness: It is such an ascertained fact now that paraffine is made from coal, that it is difficult to say whether it was made then or not.

Mr. GROVE: Was it generally known—at any rate, was it known to chemists?

Witness: No; the temperature in gas works varies a great deal. It is desirable to avoid an excess of high temperature, but that depends upon the quality of the coal.

Mr. BRAMWELL (in re-examination): Is it desirable, in the manufacture of gas, to avoid an excess of low temperature? (Laughter.)

Witness: Yes; because you can't get gas at a low temperature.

Mr. *Samuel Clegg*, examined by Mr. BRAMWELL, Q.C.

I am a gas engineer.

Mr. BRAMWELL: I believe you are the father of gas lighting? You have been as long employed in gas manufacture as gas making itself has existed?

Witness: Yes; I know the tar that is produced in the process of gas making. I have seen the oil produced by the plaintiff's invention. I never heard of such an oil before the plaintiff's patent. I am well acquainted with the different uses made of the residuum of gas making, but I never heard or knew that paraffine oil had been or could be obtained from it.

Cross-examined by Mr. HILL, Q.C.: I saw experiments made in Manchester with the defendant's process of gas making. The heat used was perhaps higher for the hydrogen than that used in making common coal gas. It was a bright red heat by daylight.

Re-examined by Mr. BRAMWELL, Q.C.: That was about three years ago last March.

Mr. *Daniel Stone*, analytical chemist, of Manchester, examined by Mr. HINDMARSH.

In the year 1850, I was employed by the defendants in making experiments upon resin tar, with a view of seeing whether any products of a commercial value could be obtained. The defendants at that time were using resin, instead of coal, in their process of gas making. I examined resin tar in order to see whether it contained paraffine, but it did not produce any. Naphthaline can be produced from it. Naphthaline has often been confounded with paraffine. It is an article produced at a much higher heat than paraffine. When I produced the naphthaline, Mr. White directed me to ascertain whether it was paraffine.

Cross-examined by Mr. HILL, Q.C.: I was employed in the spring of 1849, to analyse the tar produced from resin used in their gas manufactories at Rhodes and Southport. The defendants were at the time setting up a chemical distillery in Salford, for the purpose of distilling the tar and getting the products; and my object was to ascertain whether its products were of any commercial value.

William Collier examined.

I was formerly in the employ of the defendants, and was present at the experiment in the course of which Mr. Hodgetts was killed. Experiments were made upon the resin produced in the defendants' gas works. They were distilling the resin tar, in order to see whether its products were worth anything. I never saw any paraffine or paraffine oil produced. The defendants began to use Boghead coal, as near as I can recollect, between Easter and Whitsuntide in 1852. They experimented upon the tar from the Boghead, and obtained paraffine from it by the same process as they used with the resin tar. The Boghead tar came from their works at Rhodes.

Cross-examined by Mr. HILL, Q.C.: They pursued the same course of distillation with the tar from the Boghead coal as they had done with the resin tar. I never was at the defendants' works at Rhodes.

Re-examined by Mr. BRAMWELL: When Messrs. Hodgetts, Clipp, and Lowe were killed, they were experimenting upon resin tar.

Mr. BRAMWELL said that now the depositions would be intelligible. [The learned counsel then put in the deposition of Mr. White, taken on Feb. 15, 1851, before Mr. Hereford, coroner, and read the following passage from Mr. White's evidence:—"The manufacture was for the purpose of making naphthalised oil, a kind of hard, waxy substance called paraffine. . . . The worm must have been stopped by the paraffine, which would have passed through, but had collected in the worm, through the distillation being carried on too slowly. The result was a very high pressure, which caused the accident."]

Lord CAMPBELL: The object of this is to show that he mistook naphthaline for paraffine?

Mr. BRAMWELL: Yes, my lord; for he attributes the accident to the obstruction of the pipe by paraffine, which could not have been there.

John Walker, examined by Mr. HINDMARSH.

I live at Manchester. I was employed for some years by the defendants, the Hydro-Carbon Gas Company. I went into their employment in 1851, at Clark's, at Pollard-street, and afterwards at Rhodes. We first used Wigan cannel for gas making, then Lesmahago, and Boghead cannel. The heat which the retorts were kept at was a red heat—between a low red heat and a high—rather a low red heat.

Lord CAMPBELL: Was there any time when the degree of temperature was changed?

Witness: No, my lord. It was never got up to the original heat as worked at the experiments at the Manchester gas works. The order to work at this heat was given me by Mr. Ginty, the Hydro-Carbon Company's gas engineer. We did not get so much gas when we used a low heat. Sometimes, when we used the Boghead cannel coal, the yield of gas was as low as 9000 cubic feet a ton, and sometimes as high as 30,000. When we used a low red heat we did not get enough, and I told Mr. Ginty, our gas engineer, so, and he told me not to get the heats any higher, or I would burn the retorts. Notwithstanding these orders, when the manager's back was turned, I used to raise the heat, and then I got more gas. I did not take any notice of the tar.

Cross-examined by Mr. HILL, Q.C.: Myself and two others were employed in making gas to light Mr. George Clark's works. There we used the Wigan cannel. The coke I used to heat the furnace, and the tar I sent to the distillery in Salford. I continued to work at Mr. Clark's until March, 1852, and I went then to Rhodes, where retorts had been erected for lighting Salis, Schwabe, and Co.'s factory. Complaints were made that the gas did not give a sufficient light when such a quantity was produced.

Mr. HILL: Was it not in consequence of that, that Mr. Ginty told you not to use so high a heat.

Witness: No; he said not to use so high a heat on account of the retorts. There were two sorts of complaints—that the gas was too rich; and, when too much was produced, that there was too little light.

Re-examined by Mr. BRAMWELL: The gas which was too rich was produced at a low temperature; it smoked. Gas produced at a very high temperature will not illuminate well; but at the defendants' works we never used as high a temperature as they generally use at ordinary gas works.

Mr. BRAMWELL then put in the defendants' invoice of the carboy of paraffine oil, purchased by Wilde, to prove that the defendants used that description for their oil.

This closed the plaintiff's case.

Mr. HILL, Q.C.: Before I address the jury, I would call your lordship's attention to the specification, in order to keep distinct, questions of law and matters of fact. Your lordship will see that the title of the patent is, "Improvements in the treatment of certain bituminous substances, and in obtaining products therefrom." And then the patent specifies coal as the only "bituminous substance." [The learned counsel then read from the specification the plaintiff's description of his process.] The plaintiff winds up his specification with this claim—"Having thus described my invention, and the best means with which I am acquainted for performing the same, I hereby declare that I claim as my invention the obtaining of paraffine oil, or an oil containing paraffine, and paraffine, from bituminous coals, by treating them in the manner hereinbefore described." Now, your lordship will bear in mind that the evidence given by the plaintiff's witnesses—with the exception of Dr. Angus Smith, whose evidence comes to nothing—agrees in this, that, so far as the process described in the plaintiff's specification is concerned, there is nothing whatever new in it, except the application of low heat to the distillation of coals. The distillation of coals was well known before, and the mode of distillation by the retort was commonly practised. Now, my lord, the first objection I put to your lordship upon this specification is—its uncertainty. It is perfectly uncertain from this specification whether the patentee claims this mode of treating the bituminous coals, by which to obtain the paraffine oil or paraffine, or whether he claims as his invention the obtaining of paraffine oil from bituminous coal, no matter how, or by what process. That, I submit to your lordship, is one objection in law arising on the face of the specification. The plaintiff says:—"My invention consists in treating bituminous coals in such a manner as to obtain paraffine," but does not say, "in the manner following." He does not say whether he claims the production of paraffine from bituminous coal without regard to any particular process, or whether he claims its production by the distillation of the coal at a low temperature. My next objection is this—that he does not, in the least way, point out what is new, and what is old, or whether he does not claim the whole of the process as mentioned in his specification, and which relates both to the distillation of the coals, and also the distillation and rectification of the products; and, if he claims only a portion of them, he has not pointed out what that portion is, so that the public are left in the dark as to whether they may use all or any portion of this process—it being clear, from the evidence, that that which relates to the distillation and rectification of oil was well known before, as regarded the distillation and rectification of oil, and it also appearing that a considerable portion of the process with regard to the distillation of coal was well known before. These, my lord, are the points which I submit to your lordship.

The ATTORNEY-GENERAL, in reply, said: When you come to look at the whole specification, I submit that it becomes very clear. The plaintiff goes no further than this—that he claims the application of a process (which he does not assert to be new) to a new substance, for the purpose of producing from that substance, by that combination and treatment, a product which has never been obtained from it before. He does not say that paraffine is a new thing, or that his process is a new thing, or that bituminous coal is a new thing; but he says that the application of that process to bituminous coal for the

purpose of obtaining from it paraffine oil is altogether, in its combination, a new thing. It is impossible to read the specification, and not to say that that is the effect of it.

Lord CAMPBELL: Then, unless there were some novelty in the process, the mere application of it would not be properly the subject of a patent. Merely suppose that this were a well-known process, that had been applied to other purposes. The mere application of it to obtain the paraffine would not properly be the subject of a patent.

The ATTORNEY-GENERAL: I would submit this to your lordship as clear and indisputable—that the application of a process like distillation—perfectly known and familiar—to a substance new for that process, with a view of obtaining from it a product which had never been before obtained, and which it was not in the knowledge of mankind previously could be obtained by means of distillation.

Lord CAMPBELL: Well, then, what do you say is his claim?

The ATTORNEY-GENERAL: The application of this process to bituminous coal for the purpose of producing from that application a product which has never resulted from it before, and which it was not known it was possible to produce.

Mr. HILL: If your lordship directs that my grounds of objection are insufficient, I would, with the greatest respect, tender a bill of exceptions.

Lord CAMPBELL: I think that any question that might arise might be put in the best manner that would enable both parties to take the opinion of a superior court. You may tender a bill of exceptions; there will be no difficulty in that. You say that upon the issue that there is no sufficient specification, I, having read the specification, ought to direct the jury that it is insufficient. Now, I direct them that it is not insufficient; that is a question of law, and you may take the opinion of a superior court by tendering a bill of exceptions.

Mr. HILL: The more formal mode, my lord, will be to tender the bill of exceptions after you direct the jury.

Lord CAMPBELL: You would be perfectly right in doing it now.

Mr. HILL: My next question is—does your lordship think that there is a case to go to the jury?

Lord CAMPBELL: I think there is.

Mr. HILL then addressed the jury for the defence. He said: Gentlemen of the jury, you have already been occupied a considerable number of hours in the consideration of this case, and I feel, in presenting the defendants' case to you, that I labour under the same difficulty which too often embarrasses the defendant's counsel when he comes before a jury to introduce his client's case after the plaintiff has had his most fully gone into, so as to prepossess the minds of the jury so strongly with it that the defendant's case is not received with that favour which it might have met with if it had the advantage of precedence. I am quite sure, however, gentlemen, that you will, with a most impartial judgment, give the same attention to the defendant's case as you devoted to the plaintiff's. I shall endeavour not to occupy your time unnecessarily, but I shall call your attention directly to the points on which you are to decide, and to the evidence given by the plaintiff in support of his case, and the evidence which the defendant intends to adduce in support of his. There are two, and only two, questions upon which you will be called upon to give your decision. The first question—according to the mode in which it is raised in the pleadings—is, was the plaintiff the first and true inventor of this patent—that is to say, was this alleged invention new in this country at the time of the patent? The second question you will have to decide is—have the defendants infringed that invention? You will have to adjudicate between the parties on those two questions. Now, in order to decide upon those questions, it is of the utmost moment that you should know what is the plaintiff's invention; and that is one of the objections which I stated to my lord, as a question of law, and a question of the most vital importance, not only to the defendant, but to the commercial public at large—that it was not possible to find out what is the invention for which the plaintiff claims the protection of these letters patent. That is one of the reasons why I stated that I was unable to ascertain whether he claimed the obtaining of paraffine oil, or claimed only obtaining it by the use of a particular process; and, if he claims it only by the use of a particular process, then I want to know how much he claims of the process named in the specifications. Now, we will presume that his claim, as the Attorney-General says, is the obtaining from coal, though by an old process, of a product which was not known to exist in coal before. Perhaps the Attorney-General will correct me if I misdescribe the claim, as he represented it.

The ATTORNEY-GENERAL: Assuming the process to be a known process, if you apply that known process to a substance to which it has not been applied before, and obtain a fresh product which has not been obtained before, then that is a new and true invention.

Mr. HILL: But a process here applied to a substance to which, I beg to say, it has been extensively applied before. Now, a word or two upon the evidence they have offered to show that this is a new invention. An array of witnesses, formidable from their high reputation as scientific men, have been called before you, in order to prove the novelty of the plaintiff's invention. You have had Dr. Lyon Playfair, Professor Graham, Dr. Hoffmann, Dr. Fyfe, and others high in repute in the scientific world, and to whom I am willing to pay that deference and homage which the public accord to them. They say that in their judgment, and according to the knowledge they had at the time of the patent, the plaintiff's was a new invention. The only witness who speaks of paraffine as an ingredient in bituminous coal is Professor Graham, who said that he had a suspicion that bituminous coal contained it. Paraffine, then, is proved to have been known. Now, I request your attention particularly to this, because it will be of importance, when you look at the works which I shall presently refer you to. They say that it was known that paraffine had been produced from beech-wood tar, and from wax and peat; for every one is familiar with the Irish attempt to make wax-candles from turf, as it has been said. It was also known to have been produced from bituminous schist; but the witnesses add, that it was not known commercially, and that it had only been produced from these substances by way of experiment. I put the name of Du Buyson to them, to ascertain whether they knew that he had made it in commercial quantities. They admitted that Du Buyson had produced it, but not commercially. It will not escape the attention of my lord, that the title of the plaintiff's patent—"Improvements in the treatment of certain bituminous mineral substances"—does not say a word about coal. Now, look at that, for it is important to watch what the state of the public knowledge was at that time. As you are aware, a person who takes out a patent must, within six months, enrol the specification describing his invention; that being, as it were, part of his bargain with the public. Now, the title of the plaintiff's patent said not a word about coal, so that no one would imagine that it was confined to coal; but in the specification there is not a word about any bituminous substance except coal. Now, I shall put in the specification enrolled by M. Du Buyson in 1845. I don't say that this, in itself, renders the plaintiff's patent old.

Mr. BRAMWELL: There is no mention of Du Buyson's patent in the notice of objections given to us.

Mr. HILL: I don't say that Du Buyson's patent will make yours old. I merely put it in, in order to trace the chemical knowledge of the day.

Lord CAMPBELL: You give it as part of your case, to show that this is not a new invention. You have given the plaintiffs a list of the books you intended to refer to; and, as this patent is not included in that list, I don't see how you can make use of it.

Mr. HILL: I would submit to your lordship that in this way it might be admissible——

Lord CAMPBELL: It would be a mere evasion of the rule. Either it is evidence for this purpose, or it is not. If it be not evidence for this purpose, then it is wholly irrelevant; and if it be evidence, then it is inadmissible, because you have not given any notice of it.

Mr. HILL: But they have called witnesses who have spoken from their chemical knowledge. Now, I was about to show that this invention was known before the plaintiff's patent. However, if your lordship says that I cannot put in this patent, I will not press it, but I shall ask your lordship to take a note of it.

Lord CAMPBELL: Is it objected to?

Mr. BRAMWELL: I really don't know what it is, and, therefore, must object to it.

Lord CAMPBELL: Well, then, I cannot admit it.

Mr. HILL: Then, gentlemen, I must rely upon the evidence given by the plaintiff's own witnesses, that, before his patent, it was known that paraffine had been obtained from bituminous schist. In this case there is one very remarkable fact which I pray you to bear in mind—that no witness has been called before you who has shown that any coal, except the Boghead cannel, was ever used by the plaintiff for the purpose of producing this paraffine oil. Young states that the only coal he ever used was this Boghead cannel coal; and one of the witnesses gave it distinctly as his opinion that the Boghead cannel was not a coal, but a bituminous schist. Mr. Binney, the attorney, considers that it is a coal—contrary to the opinion of Mr. Leigh, who is a scientific man. The only mineral substance, then, which the plaintiff has used has been this Boghead cannel coal. There is another circumstance I would direct your attention to—and that is, that no one witness has been called before you who has ever said that any experiment was ever made on the tar produced from Boghead cannel coal, used in the ordinary process of gas-making, with a view of seeing whether paraffine oil could or could not be obtained from it. Not one of them had ever made such an experiment; and you will find that point to be exceedingly important. Well, then, the question is this—Was the plaintiff's invention new? His lordship will tell you, I think, that it is not necessary to show whether it was actually used.

Lord CAMPBELL: It will be enough if you produce publications substantially describing this invention.

Mr. HILL: My lord, as indeed I expected, relieves me from arguing that point. There was a decision in the Court of Common Pleas, which has established that principle of law with regard to patent right. In that case, though it was left to the jury whether the plaintiff received his information from certain books previously published, the Lord Chief Justice Tindall decided that, though the plaintiff might have truly discovered the invention without having received any information in such a way, yet, inasmuch as his invention had previously been described in a scientific journal so as to enable any practical man to carry it out, the invention was no longer a new one. Now, I will call your attention to some passages in the works which I referred to yesterday, and which the witnesses said were familiarly known to all chemical men before the date of the plaintiff's patent. I hope some of you are chemists, for then you will be the better able to ask yourselves whether every material part of the plaintiff's invention is not to be found in these publications. The first book I will read from was published in 1842 by Sir Robert Kane, then Dr. Kane. It is entitled "The Elements of Chemistry, including the most recent Discoveries and Applications of the Science to Medicine and Pharmacy, and to the Arts," and at pages 1097 and 1098 it contains the following passage, under the head "Products of the Distillation of Coal":—"The products of the distillation of coal in close vessels possesses a remarkable analogy to those that have been now described, and indeed, in many instances, are identical with them" [that is to say, the products of wood tar, which the writer has just described]. "Thus the gaseous products are marsh gas, olifiant gas, and carbonic acid; the liquid products consist of various bodies closely analogous to petroleum; and the solid consist of naphthaline and paraffine. The relative proportions of these products vary with the temperature—*the lower the heat employed the less gas and the more solids and liquids are produced*"—[the solids mean paraffine]—"and the higher the temperature, the greater is the quantity of carburetted hydrogen; but for the purposes to which the practical process is applied, the temperature must not be raised too

high, for then the gas evolved would be most marsh gas and pure hydrogen, which possess little illuminating power, whilst a great deal of illuminating power may be derived from the vapours of some highly volatile liquid products. In the manufacture of coal gas for the purpose of illumination, the object is, therefore, to maintain a temperature too high for the production of much naphthaline or paraffine, but not high enough to produce hydrogen or marsh gas, and thus obtain the greatest possible quantity of a gaseous product of olifiant gas and vapours of liquid carbo-hydrogen." You can see now, gentlemen, why it is they were so anxious yesterday to keep the books out.

Lord CAMPBELL: They did not evince any anxiety to keep them out.

Mr. HILL: Well, gentlemen, what do you understand from Sir Robert Kane? Does it not appear from the passage I have read that in 1842, paraffine was a well-known product from the distillation of coal at a low temperature? Here it is. There cannot be the least doubt about it. One of the most popular books on the science of chemistry—a work which had so extensive a sale that it went through a second edition in 1849—clearly states that paraffine could be produced from coal by distillation at a low temperature; and that, according to the plaintiff's witnesses, is the only novelty in his invention. Now, here it is stated distinctly, that in order to obtain paraffine you must have a low temperature, and that, in the ordinary distillation of coals for the production of gas, you have a temperature too high for the production of paraffine. Can there be any doubt, then, that it was well known before the plaintiff's patent that paraffine could be obtained from coal by distillation at a low temperature, and that any one could do, from Dr. Kane's directions, what the plaintiff describes in his specification? But, then, they will say, "There is not a word in Dr. Kane about oil, so, as far as the paraffine oil is concerned, our invention is new." Now, I will call your attention to another book—Mitscherlich's Chemistry, translated by Dr. Hammick, and published in the year 1838. It is called "Practical and Experimental Chemistry applied to the Arts and Manufactures." In the 12th section, page 201, there occurs the following passage:—"EUPIONE.—PARAFFINE.—By distilling coals, as well as animal and vegetable substances, an oleaginous, besides an aqueous fluid is formed. If the oleaginous fluid be submitted to a distillation, there first passes over an aqueous fluid, on which the oil floats, and next an oleaginous body that sinks, after some time, in this fluid. By changing the receiver, collecting, until complete carbonisation of the employed mass takes place, the substance that passes over, then *paraffine is obtained in considerable quantity*. The same operation may be repeated several times with the substance that has passed over; at last, a mixture of empyreumatic oils, with paraffine and eupione, is obtained. By gradually adding half the quantity of sulphuric acid, by weight, during continued agitation, then the empyreumatic oil is decomposed. When the mass becomes very fluid, it is placed for a day in a warm spot, about 140°. There collects then on the surface a clear colourless oil, which may be taken up in a fluid, or, if the mass be allowed to become firm, in a solid state on cooling. This is paraffine, impregnated with a volatile oil." Why, this is the very thing that the plaintiff has invented! Here are two works—one published in 1838, and the other in 1842—both describing the very way that the plaintiff obtains paraffine and paraffine oil. There is no doubt, gentlemen, I may as well mention, that paraffine oil is an oil holding paraffine in solution, and from which paraffine may be produced. Now, the following is a passage from the "Encyclopædia of Chemistry," published at Philadelphia in 1850, but which I shall prove was sold in this country before the date of the patent. The passage occurs under the head—"Products of Dry Distillation":—"These products are somewhat analogous to those derived from wood, and some are identical with them. Thus the gaseous products are light carburetted hydrogen, or marsh gas, olifiant gas, and carbonic acid; the liquid products consist of various bodies, closely analogous to petroleum; and the solids consist of naphthaline and paraffine. The relative proportions of these products vary with the temperature—*the lower the heat employed, the less gas and the more solids and liquids are produced.*" M. Dumas, also, in his "Traité de Chimie appliqué aux Arts"—a work which has gone through many editions—says that paraffine and eupione are contained in the tar of animal and vegetable substances, and also in coal tar. Now, before I read the extracts from Reichenbach, I will first observe that Baron Reichenbach has distinguished himself throughout Europe as a great experimentalist. The witnesses, who have only spoken of their knowledge at the date of the patent, had not had their attention, at that time, directed to Reichenbach's works. We were not allowed, according to the rule, to ask the witnesses whether they now knew that this mode of obtaining paraffine was ascertained long before the plaintiff's patent; but there can be no doubt that there is not one of those witnesses who has not read those books since the patent. The patentee, however, is in a different position. He wishes to claim the monopoly of a certain invention, and, if he wished to make good that monopoly, he ought to have read those books, which were the chemical authorities of the day, before he applied for his patent. Now, Reichenbach's work is a book which is in the hands of all chemists. The original is in German, but I will read you a translation of a passage which occurs in his work:—"If coal tar is to be obtained free from naphthaline—which is a product of carbonisation and soot formation—we must go to work with great precaution. The carbonising vessels must not, on any account, attain a red heat; and, as this is unavoidable with coals, in order that the charge of the retort be coked to the interior, it is necessary to collect the distilled tar in separate portions, by changing the receiver from time to time, and only using those portions which we are certain came over before the retort became red hot. I always went to work in such a manner that I placed the coals in a capacious glass retort, and distilled from an iron sand-bath, which I never allowed to get red hot. So long as I operated thus, I always obtained tar which was composed of eupione, creosote, picamar, paraffine, copnomar, pittacal," &c. Baron Reichenbach was the original discoverer of paraffine, and he published his discovery in the year 1833. In other passages he speaks to the same effect:—"A pure tar," he says, "obtained at a carbonising heat, gives about 70 per cent. of oil, and scarcely 30 per cent. of solid residue." But the commercial application of this product is also distinctly pointed by Reichenbach, one of the purposes for which he says that it would be very useful is the lubrication of the wheels of carriages. When this evidence is given before you, you are to be asked to say whether the plaintiff was the first inventor or discoverer of the production of paraffine by the distillation of coals at a low temperature; and whether, because the plaintiff has patented such invention as being a new discovery, the public are to be prevented from doing what Dr. Kane and Reichenbach described long ago, and what was, in fact, the property of the public in 1849. In the face of these facts, I think you cannot help saying, gentlemen, that this was not a new invention, but that, on the contrary, every portion of it had been published a considerable time before the plaintiff obtained his patent. Gentlemen, I will not delay you longer in addressing you on this first point—whether the plaintiff is the first and true inventor. The next point is—Did the defendants infringe the plaintiff's patent? Now, the evidence as to the infringement relies upon the opinion of a great many witnesses, that paraffine cannot be obtained from coal tar. Two practical men, who say that they have been for many years conversant with coal tar, state that they have never been able to obtain from it anything but a heavy oil used for preserving wood. But none of those witnesses—from the first to the last—has ever proved that any attempt has been made to analyse the tar produced by the Boghead cannel coal, used in the ordinary process of gas-making, with a view of ascertaining whether it could be made to yield paraffine. What is the evidence? First of all, that we have sold an oil which contains about two per cent. of paraffine—or a little more than half of what the plaintiff's contains; and then they call witnesses who inspected the defendants' works—two of them being workmen of the defendants—and they say that, prior to the plaintiff's patent, the defendants were carrying on the distillation of tar, obtained in their works from the production of gas, and that they made various experiments for the purpose of obtaining, if possible, some commercial products from this tar; in fact, the defendants were carrying on business as the distillers of gas tar, and this was in 1849, long before the plaintiff's patent. At that time they were using resin in their gas works at Rhodes; but in the year 1852 they commenced the use of Boghead cannel coal, and not till then; and there is no pretence for saying that prior to that time they ever extracted paraffine, or anything resembling it, though they were trying to extract what they could make as profitable as possible. This workman said that he was told by Mr. Ginty, the gas engineer, not to raise the heat so high. Now, the defendants, unfortunately, cannot call Mr. Ginty, because he is in Rio Janeiro, erecting works there in fulfillment of a contract; but there is no pretence for saying that, at any period either in 1852 or in 1853, the defendants' works at Rhodes were not carried on for the *boná fide* purpose of producing illuminating gas for lighting the premises of Salis, Schwabe, and Co. The defendants had a contract to light that firm's extensive print works at Rhodes; and for that purpose erected a retort, and carried on their process for the production of gas. Now, when they commenced to use the Boghead cannel coal, they found the tar obtained from it to be very different from that produced by the distillation of resin. I shall call before you a highly respectable witness, whose name has been already mentioned—Dr. Frankland—who was consulted by them when they were making experiments with the resin tar, and who recommended them to use the Boghead cannel coal, which he said would be much more profitable. They acted upon his advice, and the result was that they got a very different oil, and they were not aware, when they first obtained it, what that oil was. They sent a specimen of it to Dr. Frankland, stating that they could not neutralise it, as they did the resin oil, and that they wished him, therefore, to experimentalise upon it. Having made some experiments upon it, he discovered that there was paraffine in it; and then, for the first time, the defendants were made acquainted with the fact that paraffine was in that tar; and from that time we have carried on that business, and I hope we shall continue to do so—turning the tar to as profitable an account as we could, by making this oil from it, and then selling the oil. I will call before you the persons who had the superintendence, up to a certain day in February, 1853, of the defendants' works, and they will tell you that the works have been carried on *boná fide* for the purpose of making gas. But the case will not rest there. I will adduce a strong confirmation of the defendants' case. I will call the manager of the Chartered Gas Company, and he will tell you that, during the last three years, that company has been obtaining, and to a very profitable extent, paraffine from the tar which is produced by the distillation of coal in their process of gas manufacture. Will it be pretended that the Chartered Gas Company has infringed the plaintiff's patent? The Chartered Company has been doing the very same thing as the defendants: in manufacturing their gas they have obtained paraffine; and they have done further—they have been able, like the defendants, to dilute it; and that is the reason, probably, that it contains less paraffine than the plaintiff's. We will distinctly prove to you that that company has used between 4000 and 5000 tons of this Boghead coal; and, having rectified the tar produced by that coal, they have been able to produce paraffine oil, and that oil has been used for lubricating machinery. The manager of the Chartered Gas Company's works will prove that fact most distinctly; and I think it will go far, in your minds, towards proving our case, that we have not been guilty of any infringement of this patent. Why is it that paraffine was not known before as a commercial article? Boghead cannel coal was not known until the year 1850; and I think it was in the year 1851 that it was first advertised extensively in England, and that a market was obtained for it, for the manufacture of gas. You will find that it is the Boghead coal that has made the manufacture of this paraffine so easy and so profitable.

But another part of the case is this—I will call before you witnesses who will be able to tell you of the experiments they have made on common gas tar, and how far the results agree with the one given by Reichenbach and other scientific men. I shall put it beyond all doubt—both from the evidence of those gentlemen, and from the books I have referred to—that paraffine and paraffine oil, or, rather, an oil containing paraffine, were well-known products from the distillation of coal, and that it was known, moreover, to all chemists, that, in order to obtain paraffine in any quantity, it was necessary that the distillation should be at a low temperature. I shall prove that the mode in which we have carried on our works has been *bonâ fide* for the purpose of carrying out our patents for the production of illuminating gas; and the evidence of the plaintiffs' witnesses shows that we were manufacturing oils from the tar, and endeavouring to turn them to a profitable account, long before the plaintiff's patent. Dr. Stenhouse says that, if we follow out the process in our specifications, we would produce paraffine. We have not varied from our specifications, and yet they are now trying to stop us from doing what we have a patent right to do. The two questions, then, which you will have to decide, gentlemen, are—First, was this a new invention of the plaintiff? and, secondly, have the defendants infringed it?

Mr. *Henry Stephens*, bookseller, Paternoster-row, and Mr. *Watts*, assistant librarian of the British Museum, then proved that the works mentioned by Mr. Hill were in circulation in England before October, 1850, the date of the plaintiff's patent.

Mr. GROVE, Q.C., then proceeded to read passages from the different books. The following are those which are not contained in Mr. Hill's address to the jury:—From the "Encyclopædia of Chemistry," published at Philadelphia in 1850, in p. 824—"Paraffine. Found in the petroleum of Rangoon, and is also *one of the products of the distillation of coal*, wood, and wax. Specific gravity, 0·870. A white, fusible, waxlike, indifferent substance, crystallisable in scales from its solution in ether; is inflammable, and distils unaltered; chlorine and anhydrous sulphuric acid both react upon it."—From Brande's "Dictionary of Science, Literature, and Art," published in 1842, in p. 885—"Paraffine. A substance contained in the products of the distillation of the tar of beech-wood. It is a tasteless, inodorous, fatty matter, fusible at 112°, and resists the action of acids and alkalies. It appears to be a hydro-carbon. Its name is compounded of *parum*—little, and *affinis*—akin, to denote the remarkable chemical indifference which is its characteristic feature. A similar substance has been obtained by Dr. Christison from the petroleum of Rangoon."—From Brande's "Manual of Chemistry," 6th edition, 1848, vol. 2, p. 1212—"Paraffine. When beech tar is distilled, three liquids pass into the recipient—First, a light oil; secondly, an aqueous acid; and, thirdly, a heavy oil. The heavy oil is subjected to several redistillations, and then sulphuric acid is gradually added to it, till the mixture becomes a black and thin liquid; and if it does not spontaneously rise in temperature to 212°, it is to be heated up to that point. The mixture is then kept, for twelve hours or more, at a temperature of about 122°, when a colourless oil will be found floating upon its surface, which is to be carefully poured off, and on cooling, the paraffine concretes upon its surface."

Mr. BRAMWELL: Well, but read on:—"Paraffine appears to exist in Moravia, in bituminous schist," but there is no mention of it in coal.

Mr. GROVE then read the following passage from Turner's "Elements of Chemistry," 5th edition, 1834, p. 872—"Among the products of the destructive distillation of vegetable and animal substances, is a black inflammable liquid called tar, which in aspect resembles the tar from fir. A large quantity is found during the distillation of wood, and in the preparation of coal gas. The tar obtained from such sources has been the subject of an elaborate inquiry by Dr. Reichenbach, who has discovered in it no fewer than six new principles—namely, paraffine, eupione, creosote, picamar, copnomar, and pittacal." From the same work, page 398, under the title of "Paraffine"—"This substance was discovered about the same time by Dr. Reichenbach in Moravia, and by Dr. Christison. The latter obtained it by distillation from the petroleum of Rangoon, and in the year 1831, read a notice of it before the Royal Society of Edinburgh, under the name of 'petroline.' The former procured it by distilling tar produced from the igneous decomposition of vegetable matter, especially of beech-wood, and applied to it the name under which it has become known, compounded of *parum* and *affinis*—little akin—to denote the remarkable chemical indifference which is its distinguishing feature."—From M. Dumas's "Traité de Chimie appliqué aux Arts," Paris, 1835; vol. 5, p. 654—"Paraffine and eupione appear to be contained in the tar of animal and vegetable substances, and also in coal tar."

Mr. BRAMWELL: There is another paragraph in Dumas—"Paraffine would be susceptible of being employed as a material fit to replace the manufacture of candles, if it could only be produced in sufficiently large quantities." Then he goes on, and says that it has been obtained from the distillation of bituminous schist.

Mr. GROVE next quoted the "Annales de Chimie et de Physique," by MM. Gay Lussac and Arago; Paris, 1832; vol. 50, page 77—"Eupione and Paraffine. These two substances are susceptible of different applications to the arts. It is superior to wax and spermaceti for the purposes of illumination, and is eminently serviceable for stopping and cementing, because it offers a complete resistance to acids and alkalies. It can also be used for greasing carriage wheels."

The following evidence was then given:—

Dr. *Edward Frankland*, F.R.S., F.C.S., examined by Mr. GROVE, Q.C.

I have applied myself for many years to the study of chemistry, and have been, for that purpose, in the habit of reading the French and German works on the science as soon as they are published. I am a German scholar. I have read the "Jahrbuch der Chimie ünd Physik," the 8th vol. of which, for the year 1833, contains Reichenbach's account of his experiments with reference to paraffine.

[The witness's examination was here interrupted by an objection raised by

Mr. BRAMWELL, who said that the defendants were bound to prove that this book had been in circulation in England, and that it could be obtained here, as his clients had been unable, he understood, to obtain a copy of it.

After some discussion, Mr. *Williams*, of Williams and Norton's, booksellers, Henrietta-street, Covent-garden (and whose name had been furnished to the plaintiffs as selling this book), was called, and proved that he kept the book in question in stock, and had sold it, he believed, to persons sent both by the plaintiffs and the defendants. When not in stock he could obtain it from Germany on a very short notice.

It also appeared that, on the plaintiffs making a representation to Mr. Justice Wightman that they could not obtain the book, the defendants, in pursuance of that judge's order, sent it to the plaintiffs, and left it with them for a week.

Lord CAMPBELL expressed his astonishment that, under these circumstances, such an objection should ever have been raised, to the delay of the case, and said he hoped that the time of the court would not be occupied again with such frivolous inquiries.

The witness's examination was then resumed.]

Poggendorff's "Annals" and Schweigger's "Handbook" are well known to chemists, and were in most chemical libraries before the date of the plaintiff's patent. I have translated a passage in the 8th vol. of the "Jahrbuch der Chimie ünd Physik," p. 226; it is as follows:—"Tars possess a very different chemical composition according as they are obtained from red-hot vessels, or from vessels below that temperature and heated only to the temperature of carbonisation. And this difference especially affects the amount of naphthaline, which, in the one case, may turn out to be exceedingly great, and in the other, diminish to nothing." Then, at p. 227, Reichenbach goes on to say that a large quantity of oil of tar can be obtained by distillation at a low temperature. "A pure tar," he says, "obtained at a carbonising heat, gives about 70 per cent. of oil and scarcely 30 per cent. of solid residue; but such tar which is produced at a high red heat in continuously ignited iron tubes, as in gas works, is very much loaded with black pitch and soot, and gives therefore, on distillation, scarcely one half of its amount of oil." [The witness also read the extract from Dr. Reichenbach, describing his experiments in the distillation of coal at a low temperature, quoted by Mr. H. Hill, Q.C., and which will be found in that learned gentleman's speech for the defence.] In Poggendorff's "Annales de Chimie et Physique," vol. for 1832, page 176, the following passage occurs:—"Paraffine and eupione, of which we shall speak below, appear to be contained in the tar of both animal and vegetable substances, as also *in coal tar*; nevertheless it is vegetable tar, and especially beech-wood tar, from which paraffine may be obtained in the largest quantity and with the greatest facility." In p. 178 the following mode is described of extracting paraffine from tar:—"The heavy oil of tar, several times distilled, is to be mixed and agitated with concentrated sulphuric acid, or fuming oil of vitriol, in small portions (one-twentieth of its weight), until the mixture becomes quite black and liquid, which takes place with the evolution of heat and sulphurous acid, and requires an amount of sulphuric acid equal to from a quarter to half the weight of the oily liquid. If the temperature does not spontaneously rise to 212° Fahrenheit, it must be heated to that point artificially. The mixture is then to be allowed to stand at rest in a warm place at a temperature of 122° Fahrenheit at least, so that the paraffine shall not solidify for twelve or more hours, at the end of which time a perfectly colourless liquid is observed on the surface. This, which is a compound of paraffine with a peculiar oil, is then either skimmed off, or removed as a solid cake after cooling. It is then broken in pieces, washed with water, and squeezed in blotting-paper, during which operation the oil is absorbed by the paper, and the paraffine is left behind in small leaves, which are to be purified in the manner already described, by solution in absolute alcohol, and then fused into a mass under water." The following passage occurs at page 180 of the same work:—"Both products" (viz., paraffine and eupione) "are susceptible of various manufacturing applications. Paraffine excels wax, and takes the place of spermaceti as a material for candles; and, on account of its resistance to acids and alkalies, it is of the greatest use for stoppers and lutings; it may also be used for lubricating carriage-wheels," &c. &c. I have also translated an article from Schweigger's "Journal pour la Pratique de Chimie." The article is written by one of the editors of that journal. After describing Reichenbach's discoveries, it proceeds, at p. 31, vol. 1, for the year 1834, to remark that "paraffine and those other substances are now being produced by a chemical manufacturer at Berlin in large quantities, and are to be sold at low prices. We have just got into our hands the second part of the 18th volume of the German 'Jahrbuch of Pharmacy,' and we read at p. 247, an advertisement about eupione, creosote, paraffine, and naphthaline, which a chemical manufacturer in Berlin, named Simon, states that he is ready to sell in large quantities; and, for the convenience of purchasers, he has also appointed two druggists as agents for the sale of those substances." I am professor of chemistry at Owen's College, Manchester. I have had an opportunity of seeing the gas works at Manchester. I have myself obtained paraffine from Wigan cannel coal tar, obtained from the Salford gas works, in the manner recommended by Dr. Reichenbach. I obtained paraffine oil, and subsequently, paraffine itself, from that oil. The tar was supplied to me by the tar-distillers. I usually obtained the paraffine oil first, but sometimes the paraffine is in such large quantities that it crystallises out spontaneously. I have read Young's specification, and I think that the whole of it is contained in what I have read from these books. I have seen the defendants' process at work. It undoubtedly produces a large quantity of illuminating gas. If cannel coal is employed in his process, paraffine can be produced from the residual tar. The temperature the defendants generally employ is a bright red heat. I have obtained paraffine in large quantities from the residual tar

which was produced by the defendants' distillation of cannel coal at that temperature. I was requested by the plaintiff to look over his specification, before he enrolled it, for the usual purpose of ascertaining whether it was so worded as to render the process intelligible to an ordinary workman. I gave it as my opinion that the process was explained with sufficient distinctness to be understood by a workman, and that the specification was, in that respect, properly drawn up; I suggested, however, that it would be better not to claim the paraffine oil. It was no part of my duty, nevertheless, to enter into the novelty of his invention; but, as my impression at the time was——

Mr. BRAMWELL: Never mind your impression.

Witness: I suggested to him that he should not claim the oil. I believe that paraffine oil will always be obtained in any practical course of distillation of cannel coals. In 1851 I made some experiments upon the defendants' process of gas-making with coals and cannels, with a view of ascertaining whether they would be as advantageous in the defendants' process as resin. The result showed that there was a very great increase in the quantity of gas produced by the employment of the coals and cannels. As the result obtained from the Boghead cannel coal exceeded those from any other, I recommended the defendants to use it. In March, 1852, I received from the defendants a sample of oil, which they stated possessed very different qualities from the oil they had hitherto manufactured from resin tar, and could not be used for the same purposes. They requested me to make experiments upon it, in order to ascertain how it could be converted to a useful purpose. I accordingly examined it, and I found that it contained a large quantity of paraffine. I must mention that it was a heavy oil they brought to me, but I did not ascertain whether it would sink or float in water. I recommended them to purify the oil, and sell it for lubricating purposes—telling them that paraffine was well known as being a lubricant of great value. The ingredients employed in the purification were quite different from those used by the plaintiff. I recommended them not to use any of those employed by the plaintiff, as the sulphuric acid wastes a large portion of the oil.

Cross-examined by Mr. BRAMWELL, Q.C.: You say you were familiar with all those books which have been mentioned; now, from which of them did you learn the process of extracting paraffine oil from coal?

Witness: From several; for instance, the "Jahrbuch der Chimie ünd Physik," the "Memoirs of Reichenbach," Dumas's "Traité de Chimie," Mitscherlich's work on Chemistry, and Kane's "Chemistry." These are the principal books from which I ascertained it. The "Encyclopædia of Chemistry" also gives the essential parts of the process—enough to enable one to work.

Mr. BRAMWELL: I don't mean so as to obtain it in a mere experimental quantity—as a matter of scientific curiosity—but the extraction of paraffine from bituminous coals as an article of commerce.

Witness: Oh, by the process those works describe you can produce it in large quantities. I could not have done it without referring to those books; but from them I could have mapped out the process, and then I could have done it. In my judgment the plaintiff's is not a new process of obtaining paraffine oil. I never tried to get paraffine from resin tar, nor did I ever assist the defendants in any experiments to obtain it from resin tar. I consider the Boghead cannel to be a coal. I produced the paraffine oil from tar sent to me by the defendants from their gas works, when they began to use Boghead cannel. I don't know what per centage of paraffine oil the tar produced, but I know it was a very large quantity. I did not know what quantity of coal the tar had been produced from, or what quantity of paraffine the oil contained.

Mr. BRAMWELL: Have you since ascertained that the lower the temperature the more paraffine you get?

Witness: No, I have never made any experiments with that object.

Mr. BRAMWELL: Don't you know, as a matter of scientific information, that the lower the temperature the more the paraffine?

Witness: Oh, yes, I know that, within certain limits, the lower the heat the more paraffine is produced.

Mr. BRAMWELL: So that, in order to get the largest quantity of paraffine, you would get very little gas?

Witness: Yes.

Mr. BRAMWELL: Then, I presume, all the paraffine the defendants get is, what they cannot help making?

Witness: Yes; at least, they might prevent the production of any paraffine, but then it would destroy their gas. Paraffine and naphthaline are produced, at the maximum quantity, at different temperatures—the former at a low, and the latter at a high temperature.

Mr. BRAMWELL: Where the object is the production of naphthaline, you use a high temperature, and where the object is the production of paraffine, you would use a low one?

Witness: Yes.

Mr. BRAMWELL: In your opinion, then, would a book which represented that those two substances could be produced at the same heat—would such a book teach you how to produce paraffine?

Witness: Yes, how to produce paraffine, but not naphthaline. (Laughter.) I am acquainted with the mode which the plaintiff adopts to purify his paraffine oil. After having made a series of experiments, I suggested to the defendants what I thought a better process for the purification of the oil.

Re-examined: The passages I read from those books point out most clearly that paraffine is to be obtained from coal by distillation at a low temperature. Several of them speak of the necessity of a low temperature for its production. There is nothing else in the plaintiff's specification that is not ordinarily used in gas-making. There is nothing novel in his mode of purification, as regards the use of sulphuric acid; about the caustic soda I am not so sure. The statement by Reichenbach, that a low heat would produce much naphthaline, is incorrect; but there is no other inaccuracy. A chemist, ordinarily instructed, would be able to make paraffine from the directions contained in these works. I visited the defendants' works at Southport on two occasions. The Boghead cannel coal was used there, and it was used *bonâ fide* for the purpose of gas-making. The heat was a bright red.

Mr. *Dugald Campbell*, analytical chemist, examined by Mr. HILL, Q.C.

I have been many years in practice as an analytical chemist. I was acquainted with paraffine and paraffine oil before the plaintiff's patent. The largest quantity I saw was in 1847; it was produced from a bituminous schist. It was obtained commercially.

Lord CAMPBELL: Explain what you mean by "commercially."

Witness: There was a company at Weymouth, my lord, for the purpose of distilling shales.

Mr. BRAMWELL: There is no notice of objection on that ground, my lord.

Lord CAMPBELL: I think, then, it cannot be admitted.

Witness: I was acquainted with the books which have been referred to before the date of the patent. They are all books which were in general circulation among chemists. At the date of the plaintiff's patent I was acquainted with the fact that paraffine oil and paraffine could be obtained from coals by distillation at a low temperature. No person, practically acquainted with the distillation of coals, would have any difficulty in making paraffine oil by the process described in those works. There is nothing disclosed in the plaintiff's specification which is not to be found in those books. Boghead cannel coal is extremely rich in hydro-carbon, and it is a highly bituminous substance. I do not know any coal which would produce so much gas and gas tar. In my opinion, paraffine oil can be obtained from gas tar. I have made it myself from resin tar, mixed with other substances.

Cross-examined by Mr. BRAMWELL: Mr. Anderson, of the soap works, also made some paraffine from resin tar. I experimented upon about half a gallon of resin tar, and I got, I should think, about one-tenth of paraffine oil, which I crystallised by means of cold into the solid paraffine. I never averaged, however, the proportion of paraffine to the oil; but I obtained, at least, three or four per cent. on the whole quantity of oil. That was enough for commercial purposes; and we thought we could produce it at a reasonable price.

Mr. BRAMWELL: But the public didn't.

Witness: It became the subject of a patent. The books which have been referred to would enable me to make paraffine oil. I have not made any paraffine oil from coal, but I have made some from bituminous schist. I have no doubt that these books would have enabled me to make paraffine oil from coal, particularly if the Boghead coal had then been in existence. Kane's "Chemistry" would have been sufficient to demonstrate the process of obtaining paraffine oil; and Mitscherlich's "Chemistry" is also very plain. I have not experimented upon tar produced by the use of Boghead cannel coal in the ordinary manufacture of gas.

Re-examined: Though Sir Robert Kane says nothing about purifying the oil, yet it was well known that paraffine could only be obtained through the oil. Kane mentions the distillation at a low temperature, and Mitscherlich gives the process of purification.

Mr. *Warrington*, chemical operator to the Apothecaries'-hall, examined by Mr. GROVE, Q.C.

I have been engaged since the year 1815 in chemical studies. I was acquainted with the books which have been referred to before the date of the plaintiff's patent. I do not think that there could have been any difficulty in making paraffine from the process they describe. The principles are very clearly laid down. I know of nothing new in the plaintiff's specification, except the use of caustic soda, which I was not acquainted with; but I do not know that it was new at that time. I have experimented, since this action was commenced, upon the tar produced in common gas works. I believe the tar had been produced from common pit-coal. It was obtained at the Wimbledon Gas Works, where no Boghead cannel has ever been used. I produced paraffine from that tar in my experiments.

Cross-examined by Mr. BRAMWELL: I should say, I obtained about one per cent. of paraffine on the tar. Certain quantities of naphthaline will always be produced in the distillation of coal, and will increase with an increase of temperature. When Dr. Kane says, "The less the heat, the more the solids, which consist of naphthaline and paraffine," he does not say that they are in the same proportions. Though he does not give the degree of temperature required for producing paraffine, yet any one could understand it sufficiently to work. "A low red heat" is certainly indefinite; we call the ordinary temperature of gas retorts "a full red heat." There might be 500° of Fahrenheit between two heats, which different persons might call "a low red heat."

Mr. BRAMWELL: Then he would have felt his way, I suppose?

Witness: The description of the temperature required is sufficiently intelligible to enable any one to work from it.

Mr. *William Smith*, examined by Mr. HILL, Q.C.

I am a gas engineer, at present engaged at the Bedford Gas Works. I was in the defendants' employment, and had the charge of the gas works at Rhodes from February, 1853, to December 25, 1853. I superintended those works during the whole of that time. They were used for the production of illuminating gas for the supply of Messrs. Salis, Schwabe, and Co.'s premises. The residual tar was carried from the works to the distillery in Salford. I had nothing to do with the treatment of the residual tar. The temperature which we maintained in the works at Rhodes was the same as is generally employed in all gas works; it was never, to my knowledge, purposely reduced. I never had any instructions to reduce the heat. During the period I was there, cannel coal was never once distilled at a low red heat. I have read the plaintiff's specification. The mode of distillation that we carried on at Rhodes is not at all similar to the process he describes. [The witness then described the process employed at the Rhodes works—being exactly that which is contained in the defendants' specifications.] The object was to keep the retort at a white heat; and during the whole of the time I was there, I *bonâ*

fide endeavoured to maintain that heat. I am not now, in any manner, in the defendants' employ.

Cross-examined by Mr. BRAMWELL, Q.C.: The steam introduced into the second retort did not cool it to any great extent. We used only as much steam as was necessary to create the hydrogen we required. White never gave me any instructions about the mode of carrying on the process. I had assisted him, as an engineer, in drawing out his specification, and he knew that I was acquainted with the process. I got a good quantity of gas from the works. I got as much as I could of illuminating gas, for the most gas is not always the best. I applied a heat calculated to get the greatest quantity of illuminating gas.

Re-examined by Mr. HILL, Q.C.: Increasing the heat to obtain more gas, would destroy its illuminating power. Both retorts were heated by the same furnace; No. 2 (into which the steam was introduced) was generally hotter than No. 1.

Mr. *Saville Swanwick Smith*, examined by Mr. HILL, Q.C.

I had the charge of the works at Rhodes before the last witness. I superintended them from the commencement of White's patent, to February, 1853. I have had the superintendence of nearly all the defendants' works. I have always endeavoured to keep them at a uniform bright red heat. Alterations were made in the works at Rhodes, for the purpose of enabling a proper temperature to be maintained in the retorts. Low red heats have never been used at the defendants' works during my term of superintendence.

Cross-examined by Mr. BRAMWELL, Q.C.: We used the ordinary temperature that is employed generally in gas works. The Boghead cannel coal is used at other works, which I have erected elsewhere on the hydro-carbon principle. I don't know whether paraffine has been produced or not.

Re-examined by Mr. HILL, Q.C.: I had nothing to do with the treatment of the residuum.

Mr. *Samuel Lees*, practical manufacturing chemist, and tar-distiller, examined by Mr. HILL, Q.C.

I have been in the defendants' employ. I went into their employ in March, 1851, and am at present in their employ. I have purchased for them the tar of cannel coal. I have distilled and rectified the tar, and have obtained its oils. The process of distilling the Boghead tar is this:—We put it in an ordinary iron still, and run it over; and after we have separated the naphtha, we put the paraffine oil, or Boghead oil, into an iron bath, lined with lead, and heated with steam; we then put in sulphuric acid, and heat it up by the steam to a temperature of 140°, and agitate it well, and then let it lie for twelve or twenty-four hours. There is nothing new in this process; it is the ordinary process used in the distillation of tar. We put common salt into the bath, to which we apply the sulphuric acid, and get hydrochloric acid, which is useful for sweetening the smell which is occasioned by the high temperature the tar is produced at, for the defendants use a bright red heat at their works. I used to know paraffine oil by the name of eupione, and I have heard it called mineral oil, and the paraffine was called mineral tallow. I recollect it being called by that name for twelve or fourteen years. I have read the plaintiff's specification; I cannot say that there was anything new in it, except it was the Boghead coal itself. (A laugh.) Boghead coal first came out in December, 1851. I never received any instructions to lower the heat at any of the defendants' works, nor do I know of such instructions having been given to any one.

Cross-examined by Mr. BRAMWELL, Q.C.: I knew paraffine oil eleven years before the patent. I did not make it direct before the patent, but I made it indirect. We did not apply sulphuric acid direct, because it would not pay us. We used to sell it in considerable quantities. It was my father who made it; I was then in his employ. We got 10 per cent. of oil from the gas tar; I don't know how much paraffine the oil contained, but I should say from one to two per cent. I am engaged in the defendants' chemical works. I have had, however, occasionally the management of some of the defendants' works, when any of the superintendents have been absent.

Mr. *James Gibb*, merchant, Manchester, and one of the defendants, said that his partner, Mr. De Castro, was absent, having been obliged (from his business as a Brazilian merchant) to leave London; and Mr. Ginty, their engineer, was also in Rio Janeiro, carrying out a contract for lighting that place. Neither witness nor Mr. De Castro had taken any active part in the management of their works. Mr. Lees managed the chemical works, and the two Smiths had managed the Rhodes works successively.

Cross-examined by Mr. BRAMWELL: I have not seen Mr. White during the last nine months, or he would have been here. He has not taken part in the works during the last two years.

Mr. *Miller*, another of the defendants, also stated that none of the partners had been engaged in the active management of the works, beyond occasionally advising.

Mr. *Thomas G. Barlow*, C.E., examined by Mr. HILL, Q.C.

I am a consulting gas engineer as well as a civil engineer. I have given my attention for many years to the manufacture of gas. I have known the Boghead cannel coal since its first introduction in the year 1850. It was discovered in the early part of that year, when a specimen of it was sent to me. It is the richest of all coals for gas-making. I have seen paraffine extracted from the dead oil of the residual tar produced from the Boghead coal in the ordinary process of gas manufacture. The experiment was made in the laboratory of Mr. Lewis Thompson. I heard the extracts read from the books which have been referred to. I should certainly not have any difficulty in producing paraffine, by the distillation of coal, from the instructions given in those books. The way I would determine what was meant by a dull red heat, would be this:—Iron becomes visibly red in daylight at a temperature of 950° Fahrenheit. That is the point I would start from, in speaking of temperature. I should say, then, that at 1000° you would get what would be called a dull red heat. I had publicly given rather an unfavourable opinion of the hydro-carbon process of gas-making, in consequence of its cost, and I was invited by the defendants to make a series of experiments. The heat best suited to their process is nearly a white heat. When we commenced operations, and obtained the best result, the temperature of the retorts could not have been less than 1600°; but they fell, in the course of some hours, to about 1300°, and at that period I stopped the experiment, because the gas produced at that temperature was, for the purposes of illumination, almost valueless.

Cross-examined by Mr. BRAMWELL: Where does low red heat stop and a white heat begin?

Witness: The melting point of silver, which is 1280°, is a bright red; the melting point of copper, which is 1570°, is almost a white heat.

Mr. BRAMWELL: I suppose that, though, as you say, you could make paraffine from these books, yet you would not reject the plaintiff's specification as being some help?

Witness: I would refer to it as I would to any other publication.

Mr. BRAMWELL: Do you think it more distinct?

Witness: Possibly a little more distinct.

Mr. BRAMWELL: Do you consider the statement made by Dr. Kane, that "the lower the heat employed, the less gas, and the more solids and liquids, produced," sufficiently explicit?

Witness: It is very explicit. I believe that if, instead of using a dull red heat of 1000°, you used a temperature of 600° or 700°, you would get a larger quantity of paraffine. I made the experiment, about eighteen months ago, on a small scale, and obtained it in large quantities. I consider that a dull red heat is too hot.

Mr. BRAMWELL: Do I understand you to say, then, that from any tar, produced in ordinary gas-making, paraffine oil could be obtained?

Witness: I believe that about 20 per cent. of paraffine oil can be obtained from Boghead coal tar, produced by the ordinary process of gas manufacture.

Mr. BRAMWELL: What proportion does the paraffine oil bear in weight to the coal?

Witness: You can get from a ton of Boghead coal, nearly 700 lb. of tar, and from 140 lb. to 150 lb. of paraffine oil. A ton of that coal will yield 15 gallons, and about 13 per cent. of that is pure paraffine. I have realised that myself, on a small scale.

Re-examined by Mr. HILL, Q.C.: I have never made any experiment on the tar of other coal, so that what I have said applies only to the Boghead cannel.

Mr. *F. J. Evans*, examined by Mr. HILL, Q.C.

I am manager of the Chartered Gas Company, whose works are in the Horseferry-road, Westminster. We make two sorts of gas—cannel-coal gas, and common-coal gas. We have tried several cannels—Boghead among others—and I have obtained from them, in the ordinary process of gas manufacture, large quantities of paraffine oil from the tar. We have obtained this oil for about three years. We also obtain solid paraffine in quantities. The Boghead cannel yields the largest quantity of paraffine. We have used about 10,000 tons of it within the last three years. Our company was the first which used it on a large scale. We have also obtained paraffine from common coal. Up to the present time, we have only used the paraffine for the purpose of lubricating our machinery. [The witness exhibited specimens of the crude and purified paraffine oil which had been produced in the Chartered Company's works, and stated that the tar from which the oil had been obtained was produced in the ordinary process of gas-making, and at the ordinary temperature.]

Cross-examined by Mr. BRAMWELL, Q.C.: We get only what we require for our own purposes, for we sacrifice the paraffine to the gas. The tar we get from the Boghead coal amounts to 30 gallons, or 350 lb., to every ton, or about 15 per cent.; and that will produce 6 gallons of naphtha, and 15 gallons, or 150 lb. weight of oils containing paraffine, and 19 lb. of solid coke left. The paraffine oil contains, I should think, something very considerable of paraffine—at least 20 per cent.

Re-examined: We could make more paraffine if we liked. What is not used for lubricating, is made into candles.

This closed the defence.

Mr. BRAMWELL then proposed to call scientific evidence to show that the descriptions contained in the works referred to were not sufficient to enable any one to produce paraffine from coal.

Mr. HILL objected to the admission of such evidence at this stage of the case. The plaintiff had already given evidence as to the novelty of his invention, and there was no reason why he should now adduce further evidence on the same point.

Lord CAMPBELL said that the proceeding was certainly not regular, and, after all, it was only a matter of opinion as to the sufficiency of the information given in these books.

Mr. BRAMWELL: If your lordship has any doubts as to the admissibility of such evidence now, I will not press it.

Lord CAMPBELL: I have very serious doubts.

Mr. BRAMWELL then replied (in the absence of the Attorney-General). Here were the defendants, he said, the proprietors of two patents for the making of gas—not only not patents of any invention for the manufacture of paraffine, but patents of an invention which, he ventured to say, precluded the possibility of making that commodity. Their original project was limited entirely to the use of tallow, oil, and fat; and, in spite of what one of their witnesses had said to the contrary, he (Mr. Bramwell) thought there could be no doubt that paraffine could not have been produced from the residuum of those substances, or even of resin, which was subsequently added. In the second patent the defendant mentioned incidentally that coal might be used; but he took care to say that, if it were used, the retort was to be kept at a white heat; and the evidence clearly showed that at that temperature the production of paraffine was utterly impracticable. Undoubtedly, then, if the defendant's process were fairly and legitimately carried out, with the *bonâ fide* object of producing illuminating gas, no paraffine could have been manufactured in any appreciable quantity. Now, the defendant's patents being in this condition, the plaintiff, Mr. Young, by a most ingenious process, the result of a

very attentive investigation, succeeded in producing paraffine in such quantities as to be of great commercial value, by the distillation of bituminous coal at a low red heat. This, then, was the marked difference between the defendant's and the plaintiff's patents: the former was for the manufacture of gas at a very high heat, and the latter was for the production of paraffine at a very low heat. Now, the defence which was set up was this—that the defendants were unwilling manufacturers of paraffine, and could not help, in fact, making it. The jury would remember, however, that the defendants consulted Dr. Frankland (who was subsequently consulted by the plaintiff) as to the possibility of extracting paraffine from resin; but their attempt was unsuccessful, and they never thought of obtaining it from coal until the plaintiff's invention, when they at once commenced the use of coal, and, as they said, accidentally and unintentionally obtained paraffine. Their story might be true, but it certainly was a marvellous coincidence that this profitable accident did not occur until after the plaintiff's discovery. Here was a man who had invented a process which enabled him to sell 400,000 gallons of this oil yearly, at 5s. per gallon, while sperm oil was 8s. or 9s.; and as soon as he had the command of this trade—which had never existed before his discovery—another person who had a patent for a totally different thing, and produced in a totally different way, found—accidentally—that this new and valuable commodity could be obtained by his process; but when the piracy was detected, he turned round—as usual in such cases—and declared that the invention was not a new one. Now, the plaintiff had called a great number of witnesses, who, it was admitted, were of the highest scientific authority, and they stated most positively that, before the plaintiff's patent, they were not aware of such a mode of producing paraffine; and these gentlemen were all well acquainted with the books which the defendants relied upen in order to impeach the novelty of the plaintiff's invention. These scientific gentlemen, notwithstanding their familiarity with those works, stated that the plaintiff's invention was undoubtedly new to them at the time of the patent, and that they never had heard, before his patent, of the production of paraffine except in an experimental way, but not in any commercial quantity. Nevertheless, the defendants said that these books contained a description of the very process which the plaintiff used. Yet the defendants and others knew very well that paraffine was a very valuable article; and how, then, was it that, being aware of its value and the mode of obtaining it, they never thought of producing it until the plaintiff's discovery was published? All the defendants' witnesses professed that they could make paraffine with great ease from the instructions in these books—admitting, however, that the plaintiff's description was a little plainer. They reminded him (Mr. Bramwell) of the story of Columbus and the egg. Every body was puzzled with the difficulty which Columbus proposed, until he showed them how to accomplish the feat, and then every body found it very easy. So it was with the plaintiff's invention. As soon as he made his discovery, and described his process with great plainness, every body then recollected that it was very old, and that the same thing could have been done before. But why didn't they do it, then? The only common-sense reason appeared to be—because they couldn't. (Laughter.) Now, as to the descriptions contained in those books, he (Mr. Bramwell) confessed that he was very much astonished, on looking at them, how any one could pretend that they were sufficient to indicate the process necessary for the useful production of this article. Sir Robert Kane, in his work, said that the lower the heat, the more the solids. Now, the solids included paraffine and naphthaline; and yet it was not disputed that the former of these was the product of a low heat, and the latter the resultof a high heat. Then, how could it be said that this was a description which indicated sufficiently the mode of producing paraffine, since that article was only to be obtained in quantity at a low heat, while, at that temperature, the other solid would be insignificant? But this low heat, they must observe, was incompatible with the defendant's invention, which necessitated the employment of a white heat. Sir Robert Kane (if he had been allowed to give evidence) would have told the jury more about this than his work could possibly explain.

Lord CAMPBELL: You might have called him, in the first instance, as your witness, to show that, at the time this patent was taken out, this process was wholly unknown.

Mr. HILL, Q.C.: We gave notice of his book.

Mr. BRAMWELL rejoined that it was not reasonable to expect that the plaintiff would call a gentleman to discredit his own book; but, as the defendants professed that Sir Robert Kane's book described this process, the most satisfactory way to the jury would have been to have called the author as well as his book. However, these books certainly gave no definite idea of the temperature which was necessary to be used. They merely said, "a low red heat"; and, if this were sufficient information, he repeated the question—Would it not have been done before Mr. Young's invention? Now, in 1842, Sir Robert Kane, it was said, described the process of making paraffine. Brande's "Manual of Chemistry" was published in 1848, and was a very popular work among scientific men; and yet it did not mention a word about this mode of making paraffine. All it said was—

"When beech tar is distilled, three liquids pass into the recipient—first, a light oil; secondly, an aqueous acid; and, thirdly, a heavy oil. The heavy oil is subjected to several redistillations, and then sulphuric acid is gradually added to it, till the mixture becomes a black and thin liquid; and, if it does not spontaneously rise in temperature to 212°, it is to be heated up to that point. The mixture is then kept for twelve hours or more, at a temperature of about 122°, when a colourless oil will be found floating upon its surface, which is to be carefully poured off; and, on cooling, the paraffine concretes upon its surface."

So little notion had that eminent chemist that paraffine could be obtained from coal, that he never even mentioned it. As to the process described in Mitscherlich's "Chemistry," if the defendants confined themselves to the sale of all that they purified by pressure through blotting-paper, the plaintiffs would never interfere; and Reichenbach's narrative showed clearly that his apparatus was only experimental, and that the result was only of scientific value. But the jury would have noticed, from the similarity of these passages, that one work had borrowed from another, and, after all, it was only a repetition, under different forms, of the original paragraph. Sterne, in his "Tristram Shandy," compared the compilers of books to an apothecary who compounded a diversity of drugs out of a few bottles; and so the vampers of books borrowed one from another, and made many new works without adding anything original. He would leave it to the jury to say whether they thought it possible that paraffine could be made from the information contained in those books; and he asked them to remember this simple and practical question—Was it made, or not, from those books before the plaintiff's patent? And if not, as they said in the Court of Chancery, why not? He trusted confidently that the jury would protect the plaintiff in the enjoyment of the fruits of his industry and genius, of which the defendants sought to deprive him by this undoubted infringement of his patented invention.

Lord CAMPBELL: Gentlemen of the jury, the two great questions which you have to determine are, whether this was a new invention at the time the patent was taken out, or whether it was not at that time, and previous to that time, known in England; and, secondly, whether the defendants have infringed the patent of the plaintiff. But another question has been made, upon which it is my duty to give you direction, and it is, whether the specification of the plaintiff's patent be invalid. Patents are always granted upon this most reasonable condition, that the alleged inventor has disclosed his invention for the information of the public, so that, when the time for which the monopoly is granted expires, the public may have the benefit of it; and therefore he is bound clearly and honestly to specify what his invention is, and, unless he does so, his patent is void. Now, gentlemen, one of the defences set up here is, that the plaintiff did not properly specify his invention. Now, upon that I direct you, in point of law, that there is nothing upon the face of the specification to show that it is bad; and that if you think the specification is such as would enable a workman of common skill to follow the process, and to obtain the products that are mentioned, the specification would be sufficient; and, as the defendants say that the books would be sufficient, I should think you would have little doubt in coming to the conclusion that the specification would be sufficient for that purpose. However, that and the other questions which are involved in this case are questions of fact which I will leave entirely for your determination. But then, gentlemen, the important question comes whether this really was a new invention—that is to say, that would be involved even if Mr. Young had never read one of those books, and never heard of paraffine before, and really was, by his own industry or genius, the inventor—if there were in England, before he took out his patent, books clearly and satisfactorily explaining what the process was, and instructing a person to follow out the process, and to obtain the object which he had in view, he would not be entitled to his patent; and it would be very hard if, by his taking out his patent, that which was before lawful should become unlawful; therefore you will consider whether this mode of obtaining paraffine oil and paraffine was known in England before Mr. Young's patent. Now, gentlemen, I direct you, in point of law, that if there were books then in circulation in England disclosing this mode of obtaining paraffine and paraffine oil which were known, were accessible, that the patent would be invalid, although Mr. Young never read those books, and although that mode had not been actually put in practice. If there were books in England in circulation, accessible to all who were interested in the subject, which disclosed this, and would instruct them and enable them to obtain the paraffine and the paraffine oil from the distillation of bituminous substances, then Mr. Young's patent would be invalid. That is a question for your consideration. There is certainly most material evidence for your consideration to show that there were such books; but it is for you to apply—and I hope some of you are chemists, at all events, all of you are gentlemen of education and intellect, and can apply your minds to it—it is for you to apply your minds to the determination, and to the satisfactory determination, of this question. On the part of the plaintiff, it is material that you should bear in mind the evidence which he himself gave, and that several others gave. I shall not, unless you wish it, go over the whole of the evidence. I will draw your attention to what seem to me to be the leading parts, merely to refresh your memory, if I can be of any assistance to you; but asking you to form your own conclusion. I think it will be useful to you to take into consideration what the specification is of Mr. Young. I will read over to you the material parts of it. He says—"My said invention consists in treating bituminous coals in such manner as to obtain therefrom an oil containing paraffine," &c. That is clear. The degree of heat in which the whole is left is in much more vague terms. Then he says:—"The temperature of the refrigerator should not be made too low," &c. And that is the only direction which is given with regard to the degree of heat which is to be obtained. He tells you in the former part the exact degree of Fahrenheit, but here he says:—"The retort, being closed in the usual manner, is then to be gradually heated up to a low red heat," &c. Now, the manner of purifying I think I need not read. Now, bear in mind the process that he is here describing, and say whether you think it is or is not substantially mentioned in several of those publications which have been read before you. The plaintiff himself is called as a witness, and he says he was not aware of anything of this sort. You may probably give him credit for what he said, that he did not know of this in any respect; and, what is more, Dr. Lyon Playfair, and Professor Graham, and Dr. Stenhouse, and Dr. Fyfe, say that they did not know it. I do not know that that is very material evidence for your consideration, but it is by no means conclusive, because it might very possibly have been known, and they not be aware of it; and it does seem to me that those gentlemen who have given that evidence cannot possibly have read the books that have been laid before you in evidence, otherwise I think they would not have stated several things they did state; but upon that you will

draw your own conclusion. Dr. Lyon Playfair says it was a new production from coal. But, gentlemen, it was well known to have been produced from coal long before this patent was taken out, although Dr. Playfair was not aware of it. Professor Graham says—"My attention was turned to paraffine; I had not then heard of the distillation of coal producing paraffine." You hear that the distillation of coal producing paraffine had been known to scientific men before, although the particular mode which is here specified may or may not have been practised. But that the distillation of coal produced paraffine we have clear evidence that it was known before the date of the patent. Well, then, Dr. Hoffman says, "I was not aware that paraffine had been obtained from coal." It seems to me (you will form your own opinion upon it), but it seems to me that they were by no means *au courant*—although scientific and respectable men, and no doubt speaking sincerely—when they said that they really had not read the publications, which were then in England, and which others had read and were familiar with. Dr. Stenhouse, again, says, "I think that the invention was new at the date of the patent. I then knew no mode of obtaining paraffine from coal." Now, these are the material witnesses; and Dr. Fyfe says the same—"I have seen paraffine oil produced by the plaintiff's patent. I did not know of such a production from coal before." I must say, it seems to me the weight to be given to that testimony is considerably lessened by their saying they did not know that from the distillation of coal paraffine could be obtained. Then, they all say—speaking, I have no doubt, with great sincerity—that the obtaining of paraffine or paraffine oil by distillation of coal was not known, as far as they were aware, at the time the patent was taken out.

A JUROR: Did they not all of them say, "not produced in an appreciable quantity"?

Lord CAMPBELL: They said that there might be an unappreciable quantity—that the quantity would be unappreciable—it was wholly unappreciable. I am very glad to observe that you bear in mind the very words that were spoken. I hope they will rest upon your mind, and you will give them all due attention. As far as they can judge, they do not seem at all to have been aware that from the distillation of coal, paraffine had been obtained or could be obtained, in the manner that we find described in the publications that were laid before you; but upon that you will form your own opinion, and act upon it.

Mr. BRAMWELL: Your lordship said that they could not have read these books. Dr. Playfair said that he had read Brande's "Manual of Chemistry," Turner's "Elements of Chemistry," Dumas's "Treatise on Chemistry," and others.

Lord CAMPBELL: Well, gentlemen, you will consider whether they can have read these books, and had these books in their recollection at the time they gave this evidence. Then, gentlemen, on the other side they lay before you, certainly, a very strong body of evidence, as it seems to me, to show that this mode of obtaining paraffine by the distillation of coal might be, and was, and must have been known, if you give credit to this evidence, before the patent was taken out, and obtained not merely in an appreciable quantity, but, I think, in one case it appears it was obtained and sold as an article of commerce. But, that there may be no mistake about it, I will read those passages for your consideration. Now, all those books that were mentioned to you were in circulation, and some of them for years before; and I think the American book was sold to the Museum in August, and it was in October that the specification was made. Now, gentlemen, I will read over to you what seem to be the most material passages. You will say whether those do or do not, in your opinion, disclose this process, and would, to any person who read them, be sufficient to enable a person of competent skill really to practise this process. There is, first, the "Encyclopædia of Chemistry"—"Products of dry distillation." This is from coal, and this gives an account of the products of distillation from coal:—"These products are somewhat analogous to those derived from wood, and some are identical with them; thus the gaseous products," &c. You see that is the great principle: "The lower the heat employed, the less gas and the more solids and liquids are produced. The higher the temperature the greater the quantity of carburetted hydrogen. But for the purpose to which the practical process is applied, the temperature must not be raised too high, because then the gas evolved would be mostly marsh gas, or pure hydrogen," &c. You will say whether the principle is here to be discovered—high temperature producing the gas, the low temperature the solid; and, as your object is to gain the one or the other, you generally adapt the temperature to the object which you have in view. Now comes Brande's "Dictionary." "Paraffine—a substance contained in the products of the distillation of tar," &c. I think that does not give us much information; and that would give a very slender hint, if any at all, to the making of it. Then we have Brande's "Manual of Chemistry," and under the word "Paraffine" he says, "When the beech tar is distilled," &c. You are to say what is the effect produced upon your minds, and whether a person reading this would not be entirely, and almost necessarily, led to suppose, that, if you had a bituminous substance containing the paraffine, this would give instruction as to the manner of making it.

Mr. BRAMWELL: That is beech tar that he is speaking of.

Lord CAMPBELL: I read it beech tar.

A JUROR: We understand you, my lord.

Lord CAMPBELL: Gentlemen, the next is Turner's "Elements of Chemistry," p. 398:—"Paraffine. This substance was discovered about the same time," &c. "Then, in distilling the rich tar, these liquids are obtained," &c. Then there is a reference to another part, p. 872:—"Inflammable principle of tar. Amongst the products of destructive distillation," &c. Then paraffine is here said to be obtained in the production of coal gas; not merely beech wood, but coal gas. Then of Mitscherlich's "Chemistry" we have a translation.

Mr. H. HILL: The translation is published. It is Hammick's translation.

Lord CAMPBELL: And now it is headed "Eupione and Paraffine." He says—"By distilling coals, as well as animal and vegetable substances, in olifiant," &c. You will bear this in your recollection. If you think it fit to retire, you may carry any of those books with you, and form your own opinion as to what degree of information they actually do contain. Well, then comes Dumas, and Dumas is important for this, likewise—that he shows that the paraffine was to be obtained from coal, because, he says:—"La paraffine et l'eupione dont il sera question," &c. He says that this substance called paraffine is to be obtained from the tar of coal; that is, from coal when distilled; but he treats of it as if it was not merely an appreciable quantity, but as if it was a thing well known, and of considerable importance, because he says, "Nevertheless, from this, vegetable tar is obtained with the greatest facility." He says, in truth, it was to be obtained from different substances, and, amongst others, from the "charbon de terre," or coal; and it was to be obtained, in more or less quantities, with greater or less facility, and, as I should have supposed, with more or less profit. I should have supposed that he was here treating of an article that was to be made use of in commerce.

A JUROR: What book is that, my lord?

Lord CAMPBELL: Dumas.

A JUROR: Is that the book in which he speaks of candles?

Lord CAMPBELL: He speaks of lubrication.

A JUROR: One book says it may be applied to "*boucher*."

Mr. BRAMWELL: The last paragraph but two, my lord.

Lord CAMPBELL: I shall be very glad to lay it before the jury.

Mr. BRAMWELL: Shall I attempt to translate it, my lord? It is the last paragraph but three, and the last but two. I have got an extract:—"It is a pity that this proceeding should be so long and complicated," &c.

Lord CAMPBELL: He considers it is likely to be very valuable; and that brings me to an observation which I meant to make, and which I should have been sorry if I had forgotten, Mr. Bramwell, which is this—that it was the discovery of this Boghead coal that seems to have given the great value to paraffine, because until then I do not find it was obtained in such quantities as really were of any considerable value; but the Boghead coal now being discovered, and this schist or coal being discovered, which is of a very rich quality, and having a great deal of what is the essential part of the paraffine; from that time it has become much more important; and that may explain why, although the mode of obtaining paraffine was before well known, it should not have been put in practice, because it would not appear that it could be put into practice with much profit or benefit, unless you had such a substance as Boghead coal on which you could operate. Well, then, gentlemen, with regard to the other books that were given in evidence, there is the "Jahrbuch," which contains this passage:—"If coal tar is to be obtained free from naphthaline"—I do not know that I need trouble you with reading it; you will bear it in mind.

A JUROR: No, my lord; you need not read it.

Lord CAMPBELL: Then there was a passage from Poggendorf, which was translated, and I dare say you recollect that. I will read it over if you desire it.

A JUROR: No, my Lord. Would your lordship please to give us the date of the book which referred to the advertisement in which this stuff was advertised for sale?

Mr. H. HILL: Your lordship has not the translation of that.

A JUROR: I only want the date of the book.

Lord CAMPBELL: We will ascertain that, because that is what I wish to bring to your notice, to show that it had been considered.

Mr. BRAMWELL: "Leipsig, 1834." My learned friend, Mr. Willes, says it relates to beech tar only.

Lord CAMPBELL: Although coal is talked of several times by these writers, until this very rich Boghead coal was discovered, it would appear, although the mode of extracting it might be well known, it was hardly worth while, as an article of commerce, to devote attention to it, or lay out capital upon it.

Dr. FRANKLAND: The date of the advertisement is 1833.

Lord CAMPBELL: Just read it.

Dr. FRANKLAND: The advertisement is not contained in this book, but their is a notice of it.

Lord CAMPBELL: Very well. These are the books given in evidence, which are legitimate evidence. You are to say to what weight they are entitled. If Mr. Young had read these, or somebody had read them for him, and they had put this notion into his head, and if they were sufficient, when he got the Boghead coal, to induce him to think it might be applied with great advantage to the Boghead coal, and that it would be an excellent speculation to take out a patent for it—if the mode of doing it were known, although not to the patentee, it would not be the fit subject of a patent. But if these are mere speculations and experiments, I say to you, as I have said to juries before on such occasions, that a mere abortive experiment would not prevent a person who is the inventor from afterwards taking out a patent, and availing himself of his ingenuity; still, if it was substantially known before, he has no right to do that, more than any of her Majesty's subjects, although he should be the first to take out a patent for it. In addition to these publications, you have several witnesses, who give their opinion; but your own opinion must be governed by your own judgment. You may pay some attention to the opinion which they have expressed. The first witness was Dr. Frankland. He says, "I have obtained paraffine from coal in the ordinary manner, recommended by Reichenbach, from Wigan cannel tar; I procured it from the Salford Gas Works. I obtained both good paraffine oil and good paraffine from the oil. I usually make paraffine oil first. Sometimes the paraffine is in such large quantities that it crystallised spontaneously." This he has done from coal; this, I understand, was before the patent.

A JUROR: Was that before the patent?—that is an important question.

Lord CAMPBELL: This is very important. I have not got the date here.

Mr. H. HILL: It is since the patent.

Lord CAMPBELL: But he says he merely followed Reichenbach's method. It certainly is entitled to much less weight than if it was before the patent. Then he says that the books sufficiently pointed it out, and that he finds nothing at all material in the plaintiff's specification which was not in the books. That is his statement. He says, the works point out the distillation of coal at a low temperature. Now, the great improvement and the principle upon which the plaintiff seems to ask to proceed, is earnestly pointing out that it must be at a low temperature. He does not state exactly what the temperature is, except that it is a low red heat; but he says it must be a low temperature. This witness says, in his opinion the books point out that the distillation of coal should be at a low temperature. There is nothing else in the plaintiff's specification, except what is used in ordinary gas-making—there is nothing new in the specification of this oil by the plaintiff. A person ordinarily instructed might make paraffine from the information given in these books. Then another witness, Dugald Campbell, says that the substance from which the paraffine was obtained in the largest quantities was bituminous schist. "I was acquainted with the books which were read. They were all in general circulation among chemists. I knew that paraffine oil and paraffine might be obtained from the distillation of coal at a low temperature. From the information in those books any one of ordinary skill might have made paraffine oil. There is nothing in the plaintiff's specification not in these books." Then Mr. Warrington says that he knew several of these books that have been read. "They clearly lay down," as he says, "the principle for obtaining paraffine and paraffine oil." "The only point that I was not acquainted with was the use of soda for purifying;" but the mode of obtaining it he before knew. That, I think, is the substantial part of the evidence on the part of the defendants to impeach the novelty—the books and the witnesses, and the facts which they state. Then, you must, as I said before, consider in your own opinion whether, upon this evidence, you think that this was sufficiently known to a person who, if he thought it for his profit and advantage, might have made it without any direction or information afforded by Mr. Young. If he was the inventor, and it was not known before, why, then, he is entitled to your verdict. If you think the weight of evidence is on the other side, to show the mode of obtaining paraffine from coal was before disclosed, the defendant would be entitled to your verdict upon that plea. Then the other issue is, as to the infringement; and upon that the evidence is conflicting, because it is alleged, on the part of the plaintiff, that the defendants, under the pretence of making gas, have been making paraffine. It is said they take out a patent for making gas; another, they deflect their process for the purpose of making paraffine. Then, from the low temperature which it was stated by some of the witnesses called on the part of the plaintiff, they use, one would suppose the making of gas had ceased to be their principal object, and they had turned their attention more to paraffine than to gas. They have called witnesses who have superintended the workmen employed in it, who say there has been no change; that although since they used the Boghead coal (which is the origin of all this dispute) and got the tar from that coal, and thus producing paraffine with common coal, though not in any degree profitable—it may be appreciable, but it was not profitable—since that they do find that going on carrying out their process exactly as they have done before—they do find a considerable quantity of paraffine, but that they have not changed their process; that making illuminating gas is still their object; that they are employed by Messrs. Sale, Schwabe, and Co., and, I think, by others, for the purpose of manufacturing gas to be employed for illumination; that they have done so, and that they have continued without any alteration whatever, without changing the temperature, and without changing any of the processes which they employed; that they have gone on as they had done before, although paraffine is now obtained from the changing of the coal they before used for the Boghead coal, which they have recently obtained. Well, then, gentlemen, your verdict upon that part of the case would depend upon this—whether you really believe that they have continued to use their process as they did before, without changing it with the intention of infringing the patent of Mr. Young. If they have gone on as they did before, making gas, although in the making of that gas they, by good luck, have obtained paraffine from the coal which they use, or schist, or whatever it may be, they have now that product which they had not before; and you cannot say they are continuing their old process under a pretence. You will say whether there is any evidence of their having departed from their patent; you will see whether they have continued the old process which they have practised; and if they have, then you cannot say they are guilty of infringing the plaintiff's patent, although paraffine is now produced by reason of the Boghead coal being used; if that were so, then the defendant would be entitled to your verdict upon that issue. On the contrary, if you think that they have departed from their former process, and now, instead of looking to the manufacture of gas, they have looked to paraffine, and have changed their mode of conducting their manufacture; then that would be an infringement, and the plaintiff, upon that, would be entitled to your verdict. Your opinion must be given upon that, whether they have changed their mode or not? If they changed their mode, and adopted Mr. Young's mode, that would be an infringement; but if they merely continued the old mode which they used before, then, in that case, the defendants would be entitled to your verdict.

Mr. H. HILL: Would your lordship pardon me for asking you, do you think that the evidence of the manager of the Chartered Gas Company's Works should not be noticed? They use the ordinary Boghead coal.

Lord CAMPBELL: To that I have already alluded. They used that and, using that, they had paraffine.

Mr. H. HILL: That is in the common gas works.

Lord CAMPBELL: The Chartered Company—their only object is to have gas; they, using the Boghead coal, have now paraffine, not to sell, but in considerable quantities, which they employ for their own purposes.

A JUROR: May I ask one question, my lord? It appears to me that by the plaintiff's process he gets all the oil direct by distillation; the other obtains it from the residuum. Would not that be a material point? It strikes me there is a great difference. It appears to me that the patentee obtains it by direct distillation—by the use of a refrigerator; therefore, he at once gets the oil, and gets it in larger quantities. The other gets a tar, and Reichenbach extracts it from a tar.

Lord CAMPBELL: That will be a point of fact for you to say whether the process is the same or not. That will be a point of fact, not of law.

Mr. BRAMWELL: Will you allow me upon that, to ask your lordship to direct the jury upon this. The first thing that came over we called crude paraffine oil; they call it tar.

A JUROR: They are not assumed to be the same thing. It is very material to know whether paraffine oil and tar are the same.

Lord CAMPBELL: That is a matter of evidence, and not a matter of law. I do not conceive that they are the same.

At twenty-three minutes past six o'clock, the jury retired to consider their verdict.

Mr. H. HILL: I will hand this [handing up a paper] to your lordship as my objections to the specification. It will be open to me hereafter, if I think proper to use it.

Lord CAMPBELL (after reading the paper): I left it to the jury whether the specification was sufficient to enable a workman to perform the process.

Mr. H. HILL: The law requires two things to be specified—the nature of the invention, and how it is to be performed. Your lordship has left it, how it is to be performed. It is as to the nature of the invention I call your lordship's attention.

After some time, the Jury sent for the works of Mitscherlich, Kane, and Dumas, which, by order of the learned Judge, were sent to them.

At two minutes to seven, the jury came into court.

Lord CAMPBELL: Now, first, gentlemen, I will ask you with regard to the specification:—Do you say that the specification is sufficient?

The FOREMAN: We say that it is sufficient.

Lord CAMPBELL: Then, with regard to the novelty?

The FOREMAN: We say that it is a novelty.

Lord CAMPBELL: Then, with regard to the infringement?

The FOREMAN: We say that it is an infringement.

Lord CAMPBELL: Then you find, gentlemen, for the plaintiffs?

The FOREMAN: Yes, my lord.

Lord CAMPBELL: The construction of the instrument, upon the face of it, I take it, is a question of law for the judge?

Mr. H. HILL: Yes, my lord. Does your lordship think this is a case in which execution ought not to issue?

Mr. WILLES: It is in Chancery. It cannot until next term. Perhaps your lordship will allow us to take 40s. damages; it will save the necessity of having the certificate which is made necessary by the provisions of the statute 3rd and 4th Vic.

Lord CAMPBELL: There is no objection to that.

Miscellaneous News.

TESTIMONIAL TO MR. ROBERT JONES, OF WOLVERHAMPTON.—On Thursday, June 22, the friends of this gentleman met at the works to present him with a magnificent silver tea and coffee service, and magazine of instruments, as a memento of their esteem and regard upon his leaving Wolverhampton, to enter upon his duties as engineer to the Commercial Gas Company of London. The service was got up by Messrs. Elkington and Co., of Birmingham, and consists of a massive salver, tea and coffee pots, sugar-basin, cream-jug, a dozen teaspoons, and sugar-tongs, fitted in a strong oak box. The following inscription was beautifully engraved on the salver:—

"This salver, together with a silver tea and coffee service, was presented to Robert Jones, Esq., C.E., by the officials and others connected with the Wolverhampton Gas Works, as a mark of esteem and respect, on his leaving Wolverhampton, June, 1854."

The box of instruments was furnished by Mr. Gargory, of Birmingham, and comprises a complete set of instruments, scales, &c. The cost of the whole exceeded one hundred guineas. Mr. John Fell presented the testimonial; and Mr. Homer, the company's secretary, read a very appropriate address, which was replied to in suitable terms by Mr. Jones. The company partook of refreshments provided for the occasion, and in the evening the workmen of the establishment were regaled.

CASTLETOWN, ISLE OF MAN.—Works for the lighting of this town with gas have been constructed by the Provincial and Continental Consumers' Gas Company, of Mark-lane, London, and were set in operation on the 1st inst., much to the satisfaction of the inhabitants.

CALCUTTA.—The Oriental Gas Company propose to appoint, as their acting engineer, M. Jules Danré, who designed and erected the works for the lighting of Stockholm, with great credit to himself.

WARNER'S IMPROVED DRY GAS METER.—Mr. Edge has recently made arrangements with the patentee for the manufacture of these meters, which embrace several valuable improvements upon the dry meters in general use.

THE NEW MINISTER OF HEALTH.—We have reason to believe that Sir B. Hall, M.P. for Marylebone, will be the first Minister appointed under the new bill, brought in by Sir W. Molesworth, for the reconstitution of the Board of Health. The appointment was, in the first instance, offered to Mr. Strutt, and declined by him. The salary is £2000 per annum.

PARAFFINE CANDLES.—Specimens of candles manufactured by Mr. Wagenmann, of Bonn, by the process described in the last number of this JOURNAL, have been received in this country, and have excited

much attention from their beautiful transparency and superior illuminating properties.

GAS LIGHTING IN SPAIN.—Gas works have recently been constructed for lighting the flourishing town of Santander, and Corunna will also be illuminated by gas in the course of the ensuing winter.

GAS STEALING IN THE CITY.—Mr. *John Stacey*, a plumber, in Golden-lane, was summoned before Mr. Alderman Cubitt, at the Guildhall, on the 8th inst., charged with having improperly used the gas of the Great Central Gas Consumers' Company, without compensating or informing the company of the fact. The information was limited to two days, whereby the defendant had forfeited £9.—Mr. Pontifex, the chief inspector of the company, stated that the defendant had occupied the house several months, but had made no contract to be supplied with gas. The preceding tenant had used the company's gas till he quitted the premises. It was properly cut off, and the company were surprised when they discovered that the defendant had restored the pipe in the cellar, where the light could not be seen from the street, and was using the gas in a profuse manner.—The defendant pleaded guilty, but said the company's cap had come off, and he was merely burning the waste gas out of the pipe.—Mr. Alderman Cubitt said the defendant was indebted to the mercy of the company, that it did not press for very heavy penalties. He convicted the defendant in the mitigated penalty of £5.—The defendant immediately paid the fine.

Price Current.

CASTINGS, per Ton.
Average Weight of Cast Iron Gas Pipes, per Yard.

1½ in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lbs.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow	Newcastle.	Wales.	Yorksh., Derbysh. and Staffrdsh.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Pig Iron, No. 1	5 5 0	4 10 0	4 10 0	4 15 0	5 0 0
1½ and 2 inches Socket Pipes	9 2 6	8 5 0	8 5 0	8 10 0	8 10 0
2½ and 3 do. do.	8 17 6	8 0 0	8 0 6	8 5 0	8 5 0
4 and 5 do. do.	8 12 6	7 15 0	7 15 0	8 0 0	8 0 0
6 inches and upwards do.	8 7 6	7 10 0	7 10 0	7 15 0	7 15 0
Extra for bends, branches, and connection	2 10 0	2 10 0	2 10 0	2 10 0	2 10 0
Retorts, 2nd fusion, hot blast	8 5 0	7 7 6	7 7 6	7 12 6	7 12 6
Do. 2nd fusion, cold blast	8 15 0	..	7 17 6	8 2 6	8 2 6
Tank Plates, ⅜ thick and above	8 10 0	7 12 6	7 12 6	7 17 6	7 17 6
Do. less than ⅜	9 0 0	8 0 0	8 0 0	8 5 0	8 5 0
Plain Castings ex. models	8 15 0	7 17 6	7 17 6	8 2 6	8 2 6

COALS.

NEWCASTLE.	s.	d.		DERBYSHIRE.			
Unscreened.				Clay Cross, Deep Main, and New Birchwood	8s.6d. per ton.		
Whitwell Primrose	7	6	per ton.	SCOTCH CANNEL.			
Dean's Primrose			,,	Boghead ..... at Leith	27	0	,,
Pelton	8	0	,,	Kirknes ..... best	23	0	,,
Brancepeth				Capeldrae, first quality	20	0	,,
Medomsley				Ditto, second quality	12	6	,,
Pelaw	8	3	,,	Lothian	20	0	,,
Burnhope				Lesmahago at Glasgow	23	0	,,
Eighton Moor				Ditto at Grangemouth	25	0	,,
Felling Main				Arniston	22	0	,,
New Pelton				Wemyss ... (at the pits)	16	0	,,
Peareth	8	6	,,	Bridgeness	17	0	,,
South Pelaw				Kimneil			
Waldridge				Knightswood	18	0	,,
Washington Hutton				Lochgelly	12	6	,,
South Peareth				Lumphinan			
Ramsay's Cannel	16	0	,,	Methill	11	0	,,
Cowen's Cannel	16	0	,,				

FIRE GOODS.
Best Bricks, 60s. per 1000, at Newcastle.
Do. Clay, 14s. per ton do.

LEAD.
Soft pig, £24 to £25 per ton.

WROUGHT IRON TUBING, subject to 25 per cent. Discount.

	2 inches.	1¼ inch.	1½ inch.	1 inch.	¾ inch.	½ inch.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent welded tubes, from 2 to 12 feet, per foot	1 8	1 0	0 10	0 7	0 5	0 4½
Ditto .... ,, 6 in. to 18 in., each	3 0	2 0	1 9	1 3	1 0	0 9
Connecting pieces, or long screws	3 6	2 3	2 0	1 6	1 2	0 11
Bends, springs, and elbows, wrought iron	3 9	2 3	1 9	1 0	0 10	0 8
Tees, wrought or cast	4 0	2 6	2 0	1 6	1 1	0 10
Crosses, wrought or cast	4 6	3 0	2 6	2 0	1 6	1 2
Iron cocks	17 6	9 6	7	4 6	3 3	2 6
Ditto, with brass plug	28 0	16 0	13 0	7 0	5 6	4 6
Diminishing sockets, caps, plugs, and nipples	1 3	0 9	0 8	0 6	0 5	0 4
Plain sockets	1 0	0 8	0 7	0 5	0 4	0 3
Flanches	1 9	1 6	1 3	1 0	0 9	
Syphons, 2 quart	15 0	14 0	13 6	13 0	12 0	
Ditto 1 quart	11 6	10 6	10 3	10 0	9 6	

FREIGHTS, per Ton.

Coastwise—Newcastle.	8s. 6d	*Foreign.*	9s. 6d
Chatham & Roches.	12 6	Boulogne	30 0
Cork	9 0	Barcelona	18 0
Dover	12 6	Bordeaux	16 0
Dublin	12 6	Cadiz	16 0
Exeter Quay	11 0	Calais	9 6
Folkestone	8 9	Constantinople	35 0
Hastings	10 6	Dieppe	10 6
Jersey	11 0	Genoa	30 0
London	9 0	Hamburg	11 0
Lowestoft & Yarmth	6 0	Havanna	20 0
Lynn	8 0	Havre	11 0
Margate	9 0	Leghorn	30 0
Portsmouth	10 0	Lisbon	16 0
Plymouth	10 0	Rotterdam	11 0
Whitstable	8 6	Stettin	10 0
Weymouth	10 0	Trieste and Venice	33 0

Advertisements.

TO GAS MANUFACTURERS.

FOR Sale, a small Gasholder, 18 feet diameter and 8 feet deep, with counter-balance weights, pulleys, chains, and column. Has been in use only about twelve months. For further particulars apply to Mr. HENRY HARRISON, Surveyor, Eton College, ETON, Bucks.

GASHOLDER FOR SALE.

TO be Sold by Private Contract, a small GASHOLDER, 18 feet 4 inches across, by 18 feet 4 inches deep, with iron girder, guide-rods, chain, balance ball and weights, &c., complete. For price, and to view the same, apply to the Managing Director, LUDLOW Union Gas Works.

LUDLOW, July, 1854.

25, CHARLOTTE STREET, BLACKFRIARS ROAD.

J. WINN,

GAS APPARATUS MANUFACTURER.

The Trade supplied with Gas Chandeliers, Hall and other Lanterns, Pillars, Brackets, Pendants, and every article connected with Gas Fittings, Gas Stoves, and Gas Cooking Stoves.

Patentee of the IMPROVED ROYAL SINGER for Horses.

Patronised by his Royal Highness Prince Albert, the Duke of Sutherland, &c. &c.

Estimates in Town and Country.

☞ References can be given of the highest respectability. Established in 1825.

PATENT GAS METER MANUFACTORY,
No. 66, Snow-hill, London.

WILLIAM SMITH, by the improvements he has made in the Wet Meter, and which he has secured by her Majesty's Royal Letters Patent, the accuracy of their registry is rendered certain by the introduction of the adjusting slide and hydraulic, whereby a Perfect Water Level is readily obtained, and the Hydraulic precludes the possibility of abstracting water from the meter by increased pressure or otherwise, thus surmounting the great desideratum of the Wet Meter. In his Patent Equitable Gas Meter neatness and strength are combined, the backs and fronts of the case being stamped by powerful machinery out of thick plate iron (tinned or galvanized); and the internal construction is of the best metal, which will resist the action of any impurity in the gas.

Old Meters may readily have the adjusting slide and hydraulic applied, thereby having accurate measurement assured.

Station Meters, Governors, &c., made on the shortest notice.

THOMAS EDINGTON,
IRON MERCHANT AND CONTRACTOR,
Inspector of Railway Bars and Castings,
17, GORDON-STREET, GLASGOW.

BY HER MAJESTY'S ROYAL LETTERS PATENT.

GAS Cooking Apparatus, Gas Baths,
GAS HEATING STOVES, &c.

These apparatus have been very extensively introduced, and arrangements are now completed whereby orders can be executed with the utmost promptitude.

HALDANE AND RAE,
No. 2, George-street, and No. 5, Old Physic-gardens, EDINBURGH.

Particulars may be had on application.

PATENT FIRE-CLAY RETORTS.—O. BROTHERS and COMPANY, Manufacturers of O. Brothers's Patent, beg to state that these Retorts, being made in one entire operation, and in one piece, of any required shape, length, breadth, and height, are not liable to cracks and fissures, of which there is a just and general complaint; and consequently superior to, and cheaper than, any hitherto manufactured.

GREAT REDUCTION IN PRICES—30 per cent. cheaper than any other Clay Retorts manufactured.

Shape.	Sizes.	Length.	Thickness.	Price at Railway Station, Blackburn.	Price per foot run, of any required length, at Blackburn.
		feet.	in.	£ s. d.	s. d.
Dee	12 in. by 12 in.	8	2½	2 0 0	5 0
,,	14 in. by 12 in.	8	2½	2 8 0	6 0
,,	16 in. by 13 in.	8	2½	2 12 0	6 6
,,	18 in. by 14 in.	8	2½	3 0 0	7 6
,,	19 in. by 13 in.	8	2½	3 0 0	7 6
,,	20 in. by 14 in.	9	3½	3 12 0	8 0
,,	24 in. by 15 in.	8	2½	3 16 0	9 6
Round	15 in. by 15 in.	8	2½	2 12 0	6 6
,,	15 in. by 15 in.	10	2½	3 5 0	6 6
,,	18 in. by 18 in.	8	2½	3 4 0	8 0
Oval Retort	18 in. by 12 in.	8	2½	3 0 0	7 6

All other sizes and shapes in proportion, to order.

References and further particulars may be obtained on application to the Patentee, Gas Works, BLACKBURN.

WHITWELL PRIMROSE GAS COAL.—These excellent Gas Coals are wrought from the HUTTON SEAM *only*, and can be shipped either at the South Dock, SUNDERLAND; or Old Harbour, HARTLEPOOL; or Brandling Drops, SOUTH SHIELDS; on application to the WHITWELL COAL COMPANY, Sunderland.

WEST and GREGSON,

GAS METER MANUFACTURERS, BRASSFOUNDERS, &c., UNION-STREET, OLDHAM.

Station and Experimental Meters, Gas Pressure Registers, Gauges, Experimental Gasholders, Governors, Slide Valves, &c. &c.

TO GAS COMPANIES.

NEW PELTON MAIN GAS COAL. Parties wanting a supply of these first-class GAS COALS, which are extensively used in the London and other gas works, will please to apply to Mr. JAMES JOICEY, Newcastle-upon-Tyne.

IMPROVED GAS RANGE.

CHARLES RICKETS wishes to call the attention of gas companies, fitters, &c., to his IMPROVED GAS RANGE, with white enamelled iron roasting closet, and oven, boiler, toasting fire, gridiron, and burners for boiling, stewing, &c.

It may be seen at the Manufactory, AGAR-STREET, STRAND, opposite Charing-cross Hospital.

H. JONES, Gas Meter Manufacturer, No. 44, OLD-STREET, St. Luke's, London, begs respectfully to call the attention of Gas Companies to his latest improvements in the WET METER, by means of which water cannot be abstracted, neither can Gas by any possibility pass through the Meter without registering.

WORTLEY FIRE BRICKS, GAS RETORTS, &c.

THE Farnley Iron Company respect- fully call the attention of gas companies, proprietors, managers, and gas engineers, to their manufacture of FIRE BRICKS, GAS RETORTS, &c., from the best Wortley bed of Fire Clay—well known in the Forges, Potteries, and Glass Houses of Lancashire, Yorkshire, and Lincolnshire. A trial of these goods is solicited. Orders to any extent for Fire-clay goods of every description, Patent Glazed Sanitary Tubes, Terra Cotta Chimney Tops, &c., can be undertaken and prices quoted, on application to the FARNLEY IRON COMPANY, Wortley, near LEEDS.

TO GAS COMPANIES, FITTERS, AND IRONMONGERS.

LLOYD and SUMMERFIELD, Manufacturers of CUT and FLINT GLASS Jet Moons, Globes, Hemispheres, and Chimneys of every description; Hall Lamps, Lustres, and Chandeliers of the most modern patterns.

PARK GLASS WORKS, BIRMINGHAM.

FRASER AND SANDERSON, INVERKEITHING, manufacture and sell at moderate prices, FIRE BRICKS, GAS RETORTS, SEWERAGE PIPES, and all kinds of best Fire-clay goods. They are the ORIGINAL MAKERS of Fire-clay Retorts, which work from Two to Four years, and are unsurpassed by any others.

JOSEPH BOULTON, Gas Meter Manufacturer, No. 1, COPPICE-ROW, CLERKENWELL, LONDON, begs to call the attention of Gas Companies and the public in general to his improved GAS METER, containing all the latest improvements.

J. B. warrants all Meters to be manufactured of the best materials and workmanship, the wheels, &c., being of metal. Old Meters repaired on the lowest terms.

RUTTER ON GAS LIGHTING.

HUNDRED-AND-TWELFTH THOUSAND.

ADVANTAGES OF

GAS IN PRIVATE HOUSES.

BY J. O. N. RUTTER, F.R.A.S.

A New Edition, Revised in 1853.

The sale of more than a HUNDRED AND TEN THOUSAND copies is, in itself, a tolerably good proof of the usefulness of this little book, which is intended for gratuitous distribution by Gas Companies. The Author continues to receive assurances that, wherever it is circulated, the business of the company steadily increases. Let it be remembered that, when Shops and other places of business are all lighted with Gas, a great deal remains to be done. The use of gas in private houses should receive special attention.

Price:—Per 1000 copies, £5; 500 ditto, £3. 15s.; and any less number at 12s. per 100.

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GAS IN DWELLING HOUSES:

ITS USES, CONVENIENCES, AND ECONOMY.

This book is half the size of the preceding, and its design is the same. It is written in a plain and familiar style; showing the comfort, convenience, and economy of Gas; with some practical suggestions for so using it as to realise and combine these important benefits.

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A single copy of either of the above-mentioned books will be sent, on application to the Author ONLY, by payment of the postage (2d.); and, when 1000 copies are ordered, the title, address, and scale of prices of the Company, and any other notification connected with its business, will be printed on the covers without extra charge.

In 8vo., *price* 1s. 6d., *or free per post*, 2s.,

GAS-LIGHTING:

ITS PROGRESS AND ITS PROSPECTS.

In 12mo., *pp.* 12, *price* 2d., *or* 12s. *per* 100, *Third Edition*,

STREET-LIGHTS;

And 12mo., *pp.* 18, *price* 3d., *or* 18s. *per* 100,

THE PRICE OF GAS.

Another edition of the pamphlet, entitled "Street-Lights," has just been printed, to meet the increasing demand consequent on its distribution where new contracts for the supply of gas to street-lamps are under discussion. It is pleasant to know that by such, apparently unimportant, instrumentality, the charge for gas to public authorities is becoming better understood, and the true commercial principle acknowledged, even where it is not in its fullest extent acted upon.

In royal 18mo., *pp.* 36, *with Illustrations, price* 1s.,

PRACTICAL OBSERVATIONS ON THE

VENTILATION OF GAS-LIGHTS.

JOHN W. PARKER AND SON,
WEST STRAND, LONDON.

Black Rock, Brighton, 1854.

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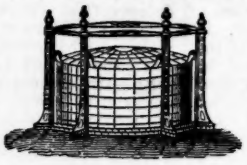
FOR THE

ERECTION OR ALTERATION OF GAS WORKS, FROM TWENTY LIGHTS UPWARDS,

With Buildings, Mains, Meters, Service Pipes, Lamp Posts, Lamps, and Gas Fittings.



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WITH BUILDINGS, STEAM-ENGINES, PUMPS, MAINS, SERVICES, &c.

Gas Stoves for Heating Churches, Chapels, Lecture Halls, and Public Buildings of all kinds; these have been recently fixed at New College, Oxford; St. George's Catholic Cathedral, Southwark; and numerous Churches, Chapels, &c. &c.

Gas Cooking Stoves and Ranges on the most improved principles.

GAS-FITTING IN ALL ITS BRANCHES.

GAS CHANDELIERS OF ALL SIZES, IN BRASS OR IRON, FROM TWO TO TWO HUNDRED LIGHTS

DEVICES FOR GAS ILLUMINATION.

IMPROVED REGISTERING TURNSTILES FOR TOLL-BRIDGES, EXHIBITIONS, PUBLIC GARDENS, BATHS AND WASH-HOUSES, &c.

These Turnstiles have been selected for the Entrances of the Great Exhibition, New York.

PATENTEES OF THE SEMAPHORE RAILWAY SIGNAL.

Signals for communication between Guard and Engine Driver. Railway Stores and Lamps of every description.

DARLINGTON WORKS, 16 TO 19, SOUTHWARK-BRIDGE ROAD, LONDON.

WOLVERHAMPTON PATENT TUBE WORKS.

WHITEHOUSE AND DIXON.

C. WHITEHOUSE, the original inventor of the WROUGHT-IRON GAS TUBES in 1824, having unremittingly given his attention to the most perfect means of manufacturing this much-required article for a period of more than thirty years, begs, with the utmost confidence, to solicit the commands of consumers generally, and especially engineers of water works under the General Board of Health, for GALVANISED WROUGHT-IRON TUBES, for water purposes, large quantities of which have been supplied to the Local Boards. Orders of any magnitude executed immediately, large stocks being always on hand, with requisite connections for Gas or Water. LAP-WELDED FLUES, for Locomotive and Marine Boilers, made of the best charcoal iron, and on the most approved method, of any diameter. Tubes for any purposes, and Brass Work of all kinds for Plumbers and Gasfitters, kept in stock for immediate requirement. Every article most carefully tested by machinery before leaving the works.

GREAT EXHIBITION PRIZE MEDAL, AND CERTIFICATE FOR GAS METERS, CLASS XXII., NO. 421.

PADDON AND FORD,

GRAY'S-INN-ROAD, LONDON,

Patentees and Manufacturers of Wet and Dry Gas Meters, Station Meters, Governors, all kinds of Experimental Apparatus, Cooking and Heating Gas Stoves, iron barrel and Fittings, Main Cocks, &c. &c.

PADDON and FORD beg to thank their friends for the extensive patronage they have lately received, and to inform them that they have made such additions to their Manufactory as will for the future enable them to guarantee the greatest promptitude.

IMPROVED

SELF-LUBRICATING GAS VALVES,

Used in nearly one hundred gas works in Great Britain and the Continent, and are esteemed for their strength, superior workmanship, non-liability to damage, never sticking, oiling themselves, always working free in tar, lime, or gas, never falling down, and their very legible index of opening of valve—advantages only possessed by these valves.

Prices, 10s. 6d. to 13s. 6d. per inch of diameter.

SELF-REGISTERING GAUGE COLUMN

To regulate the pressure in the Street Mains, showing at one glance the valve on the facing, area of the opening, size of pipe the gas passing will fill, and the pressure on the works and on the mains. This supersedes the necessity of the expense of a governor for small works, and should be placed on the by-pass, where a governor is used in large works. IT IS NEXT TO IMPOSSIBLE FOR THE VALVE MAN TO PUT A TOWN IN DARKNESS WITH THIS APPARATUS, and is a great ornament to the Valve-room.

Price:—Bright all over, £8. 10s.
Painted, £7. 10s., each, complete for fixing.

IMPROVED ANNULAR CONDENSER.

Ensures perfect condensation with smallest weight of iron, and standing on the smallest space, the whole of the parts being instantly accessible. They are in use in various Gas Works, small and large, and passing 20,000 to 600,000 cubic feet per 24 hours.

DRY LIME AND OXIDE OF IRON PURIFIERS. Perfect simplicity of action and improved Sieves, which are strong and very lasting, and the wires, when worn out, may be replaced in an hour and a half by any handy man in a gas work. The undersigned have made them, and have patterns for every size from 3 feet to 18 feet square.

GASHOLDERS, SCRUBBERS, &c.

CHARLES WALKER AND SONS,

LITTLE SUTTON-STREET, LONDON, AND MIDLAND IRON WORKS, TIPTON, STAFFORDSHIRE.

Applications for Prices, &c., to be addressed to their London Office, as above.

HARPERS AND MOORE,

DELPH FIRE CLAY WORKS, STOURBRIDGE.

London Depot,

No. 7, WENLOCK-ROAD, CITY-ROAD,

where they have always on hand a large stock of their best Stourbridge Fire Bricks, Lumps, Quarries, Burrs, Gas Retorts, Crucibles, &c. &c.

Fire goods of every description made to order.

M. KELLY, Cast Iron Wharf, 31, Bankside, London.—Retorts of superior quality, Socket and Flange Pipes, Bends, Branches, Syphons, and every description of Castings for Gas and Water Works, Gasometers, Tanks, Purifiers, Condensers, &c., erected complete, or the materials supplied.

Gas Valves and Sluice Cocks on an improved principle. Patent Gas Tubing and Connections.

A stock of the above articles kept.

The Pipes and Retorts supplied by M. K. are cast vertically, which ensures soundness and equality of thickness throughout.

PATENT FLEXIBLE GAS TUBING.

JAMES LYNE HANCOCK'S Vulcanized Indiarubber Hose Pipes and Tubing. Manufactory (and Warehouse), Goswell-mews, Goswell-road, London.

Gas Companies, Engineers, Gas Fitters, and the Trade generally, are respectfully informed this Tubing is now manufactured to any size, from ¼ inch bore and upwards, in 100-feet lengths, and perfectly cylindrical, either with or without a spiral wire inside.

VULCANIZED GLAZED FLEXIBLE TUBING, from ¼ inch up to 1 inch diameter, made in 24-feet lengths; or, covered with silk or worsted, up to 100 feet.

VULCANIZED HOSE, for FIRE ENGINES, BREWERS' USE, and for standing great pressures, (Rubber and Cloth combined), made to any length or size to fit the necessary screws, &c.

VULCANIZED INDIARUBBER AIR-TIGHT BAGS, made any size, for Gas Mains, with flexible tubes attached, and fitted with stopcocks complete.

NEW HOUSES OF PARLIAMENT.

DEFRIES'S Gas Stoves, Ranges, and BATHS, in action for two years at the above building. A great variety in stock upon the same principle. Gas Baths from £7, by which a warm bath may be obtained for 1½d. Gas Cooking and Heating Stoves, from £1. Defries's celebrated Dry Gas Meters—upwards of 60,000 in use.

Testimonials at the Office, 145, REGENT-STREET, or at the Manufactory, NEW-ROAD, St. Pancras, near Fitzroy-square.

TO GAS COMPANIES.

THE BRYMBO COMPANY,

NEAR WREXHAM,

Manufacture Cold Blast Retorts and Pipes of a very superior quality, and also ship good Gas and Steam Coals at Saltney, on the River Dee, and at Birkenhead.

Brymbo Iron Works and Colliery, North Wales.

London agent, Mr. J. W. Grazebrook, 75, Old Broad-street.

CARTER'S PATENT SAFETY GAS VALVES.

THOMAS LAMBERT and SON,

PATENTEES AND MANUFACTURERS,

SHORT STREET, NEW CUT, BLACKFRIARS, LONDON.

The Bank of England is fitted entirely with these Valves, from the smallest branch to the largest main pipe.

The following, among numerous testimonials, will be found very satisfactory:—

"The British Gaslight Company's Office, No. 105, Broad-street, Ratcliff, London, June 10, 1846.

"Gentlemen,—In reply to your inquiry, I have to state that 'Carter's Patent Gas Valve' has been used by this company and by the fitters of the district extensively for seven years past. It was adopted to obviate the inconvenience of setting fast, so prevalent with the conical metal plug-cocks, and has been found to answer the purpose intended.

"I have recommended its use in several provincial towns with which I am professionally connected, and have not received any complaint of its having failed in any respect of performing satisfactorily all that is required of it.—I am, gentlemen, yours respectfully,

"GEDDIE PEARSE.

"Messrs. Lambert and Son, Lambeth."